MACHINERY.

Vol. 7. October, 1900. No. 2

AMONG THE SHOPS.

THE SHOPS AND MANUFACTURING METHODS OF THE HENDEY MACHINE COMPANY.

The shops and offices of the Hendey Machine Company are located at Torrington, Conn., a town on the Naugatuck River, in a picturesque and somewhat isolated position as regards the main lines of travel, although in many respects well situated for manufacturing. Torrington, formerly known as Wolcottville, is on a branch of the N. Y., N. H. & H. R. R., and is one of the most important towns of the Naugatuck valley, being the seat of a number of other thriving industries besides that of machine tool building.

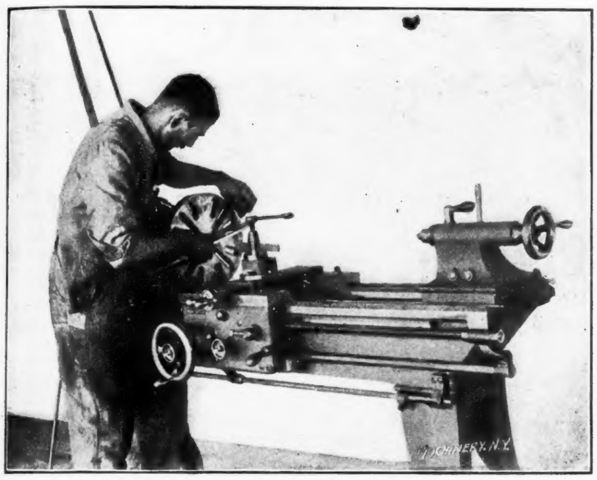


Fig. 1. Testing Alignment of Cross Slide.

The business of the Hendey Machine Company being exclusively the manufacture and sale of the Hendey shapers and the Hendey-Norton lathes, the shops and shop methods have been arranged with the singleness of purpose to facilitate their manufacture, with practically no side lines. The result of this concentration of effort is the development of a shop practice well calculated for the production of high-grade machine tools at a moderate cost, as the general results indicate.

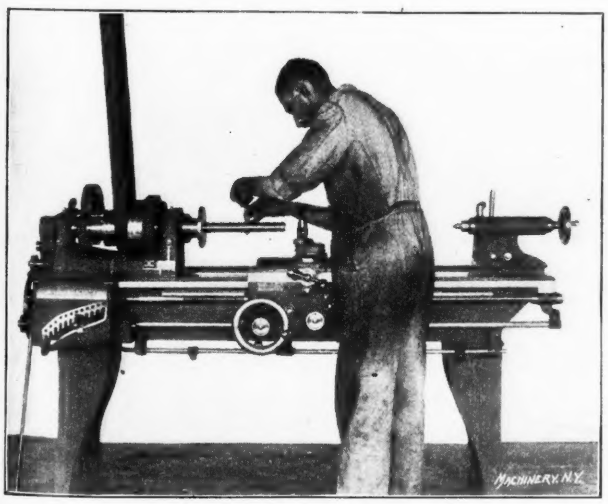


Fig. 3. Testing Alignment of Spindle.

The shop buildings are of a substantial character, well lighted, and provided with drinking water from artesian wells and sanitary conveniences on each floor. The recent additions to the works have been so planned that extensions can be made in harmony with existing conditions, a very desirable feature in view of the rapid growth during the past few years. The floor space now occupied is about 100,000 square feet.

A new power house is now in process of construction for a 500 horse-power Harris-Corliss engine and its complement of boilers. The engine is to be belt-connected to an electric generator for lighting and driving the motors for the various departments throughout the works. The power house is large enough to admit of doubling the first installation should the demands for power ever require it. The power house is isolated from the other buildings, a feature readily allowed by the scheme of electric distribution of power. A subway is built for laying

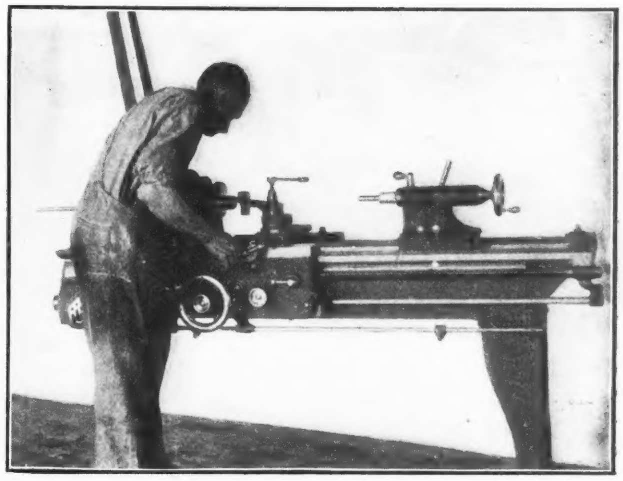


Fig. 2. Testing Taper Hole in Spindle.

the electric conductors and steam pipes for heating, thus doing away with unsightliness and dangers of overhead wiring. As intimated, the power distribution is effected through independent motors for each department. Each foreman has control of the motor or motors driving the line shafting in his department, so that the operation of one in no way interferes with that of another, as far as the power requirement goes.

The drafting rooms are on the second floor of the office build-

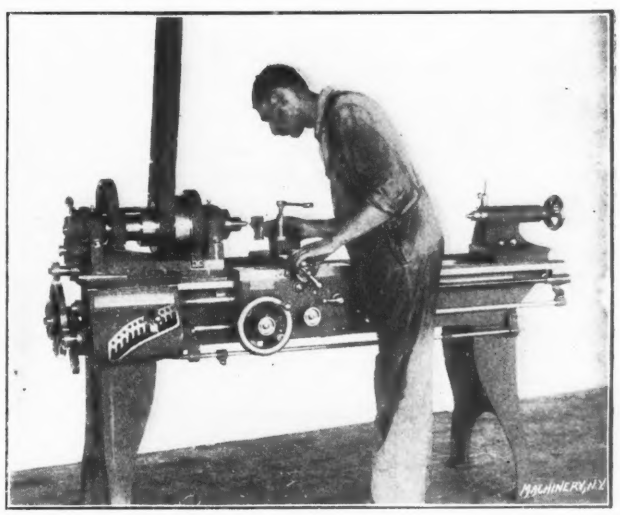


Fig. 4. Testing the Live Center.

ing in an accessible and well-lighted location. The standard drawings are all made on bond paper, the design being first done in pencil and then inked over directly on the paper instead of being traced on cloth. The blue-prints made from the bond paper drawings appear to be equal in sharpness to those made from tracings on the regular tracing paper or cloth. The cost for materials is less and the time required is also somewhat

lessened. The advantage that will appeal most strongly to the professional draftsman, however, is that the dazzling effect of the glazed surface of the tracing cloth on his eyes is eliminated. The bond paper drawings are durable, and, although somewhat more easily soiled than tracings on cloth, are readily cleaned if it becomes necessary.

The drawings for jigs and fixtures of an ephemeral nature are usually made on brown paper in pencil and sent into the shop in this condition. While these brown paper drawings are all preserved, they are not allowed to encumber the files, but are kept entirely separate from the general drawings, the latter being stored in shallow drawers in a fireproof vault.

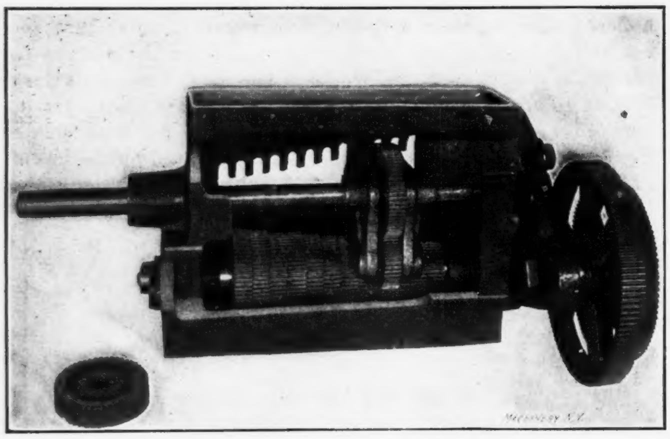


Fig. 5. Gear Box of Metric Lathe.

The various machines in the pattern room, with one or two exceptions, are driven from underneath, which avoids overhead belts and shafting to become covered with dust. The problem of pattern storage is not a difficult one, as the variety of machines and sizes is not large, and as the policy of weeding out and destroying all obsolete patterns is rigidly followed. It is believed by the management to be cheaper in the end to make a new pattern for any part of an obsolete tool, should a casting ever be required, than to be burdened with a mass of old patterns to be stored and insured.

The foundry building is a new structure, and was built with a view of installing an overhead traveling crane should the demands of the business ever make it an economical feature. At present the moulding floor is served by two Ridgeway hydraulic cranes of 5 and 10 tons capacity. The Ridgeway cranes are well suited to the needs of foundry work, as their action is steady and can be regulated for speed by the minutest variations from the slowest to the maximum rate of lift or travel. The Root blower for the cupola is driven by a 24 horse-power motor. The blast pressure is recorded on a water gage, and a ten-inch safety valve of simple construction is provided on the main pipe to prevent accidents from over-pressure. A convenience noted in the core oven is an arrangement devised by one of the men for automatically turning on the electric lights in the interior when the door is opened and turning them off when the door is closed. The effect is that the light is always present when needed, but not in action when there is no use for it, a feature of minor economy that might easily be neglected by the attendant. All the bronze castings used by the company are made in a corner of the main room. Special efforts are made to have the brass or bronze of a uniform make-up, a somewhat difficult condition to obtain oftentimes if the castings are made on contract by outside parties.

The iron castings are cleaned and pickled in the usual manner and the roughness caused by slight scabs and blow-holes is covered by filler, which, in the case of the larger castings, is applied before the machining operations are begun. By applying the filler as soon as the castings are out of the foundry it has more time to dry and harden. The abrasions it may receive during the machining operations are generally of a minor character and easily repaired by the painters when applying the finishing touches. The uniformly smooth and glossy finish of the cast-iron parts on Hendey tools shows that careful filling and painting have received much attention.

In the planer department, illustrated on page 35, is found a general planer practice that impressed the writer as favorably as any ever seen. The beds are planed by the foot and the full capacity of the planer platens is used, as evidenced in the illustration. The planer in the foreground has its platen filled with two rows of lathe carriages, which are being planed for the cross-slides. Many jigs are used for holding pieces of irregular shape to facilitate chucking. In planing the ways of the lathe beds the usual practice is followed of having a "dummy" bolted to the ends of the platen which conforms to the shape and dimensions of the beds to be planed. This makes a convenient and reliable gage for setting the planer tools and removes all necessity for measurement. It also insures that standards will be so closely adhered to that much fitting and scraping will be made unnecessary. On the small planers shown much work is done that in many establishments would be considered as belonging to the milling machine. It is a question, however, if any milling department could show the quantity of work per tool that is turned out here. For example, an instance was noted where an apprentice was machining sixteen compound rest slides at one time on a small planer. A pair of convenient and simple jigs held the parts and furnished the means by which they were quickly chucked on the platen. A "dummy" at the end gave an unfailing guide for the standard angles and dimensions. Another point of importance in the machining of such parts is that planed surfaces are more easily scraped and fitted than when milled, a very important item when it is considered that more time is usually consumed in the final fitting of such small parts than in machining them.

The headstocks are machined in gangs the same as the other parts already alluded to, and "dummies" are also used for setting the planer tools at the proper heights and angles. The jigs which hold the headstocks, center the back gear bosses in Vees, which, being smaller than the main bearings, make it more essential that they be centrally located. The slight variations in castings make the eccentricity in the larger main bearings, if there is any, not so perceptible. In the manufacture of the Hendey shapers the practice of planing the bases in gangs is also followed, it being common practice to plane eight of the 15-in. style at one time.

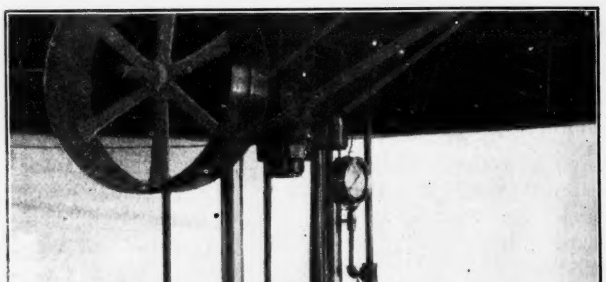
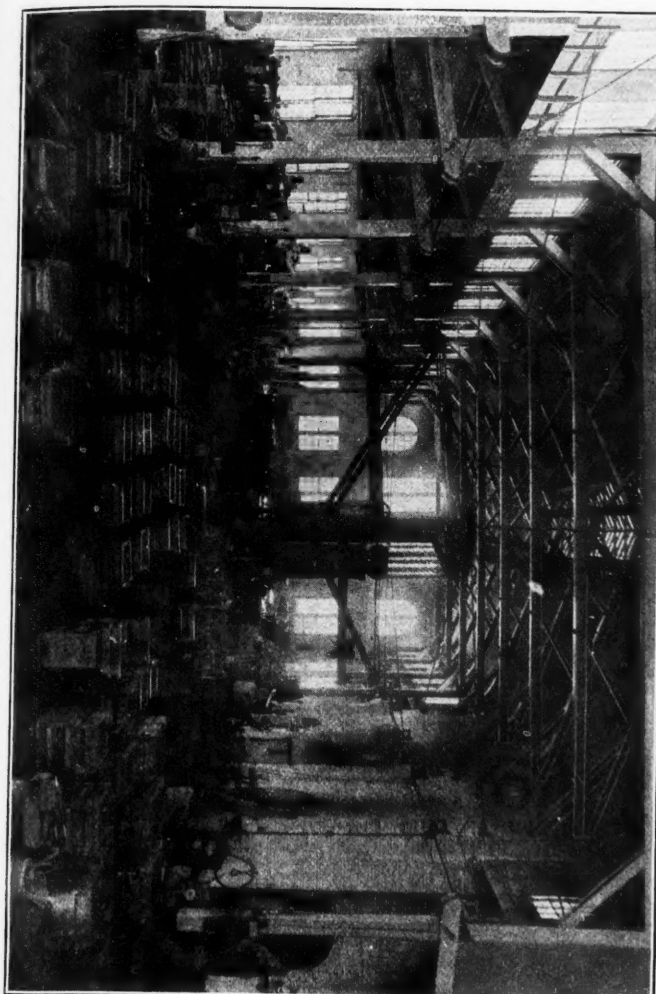


Fig. 6. Hydraulic Press for forcing home Cone Pinions, Heads, Face-gears, etc.

One of the electric motors driving the planers shows plainly in the illustration, and is typical of the plan generally followed in the distribution of power. It will be noted that the driving pulley is wide enough for two belts, which are led away nearly diametrically opposite. By this method of power distribution the strain on the motor bearings is reduced to a fraction of what it would be if the power were all taken in one direction, and thus the tendency to heating is eliminated and there is undoubtedly a considerable saving by lessened friction.



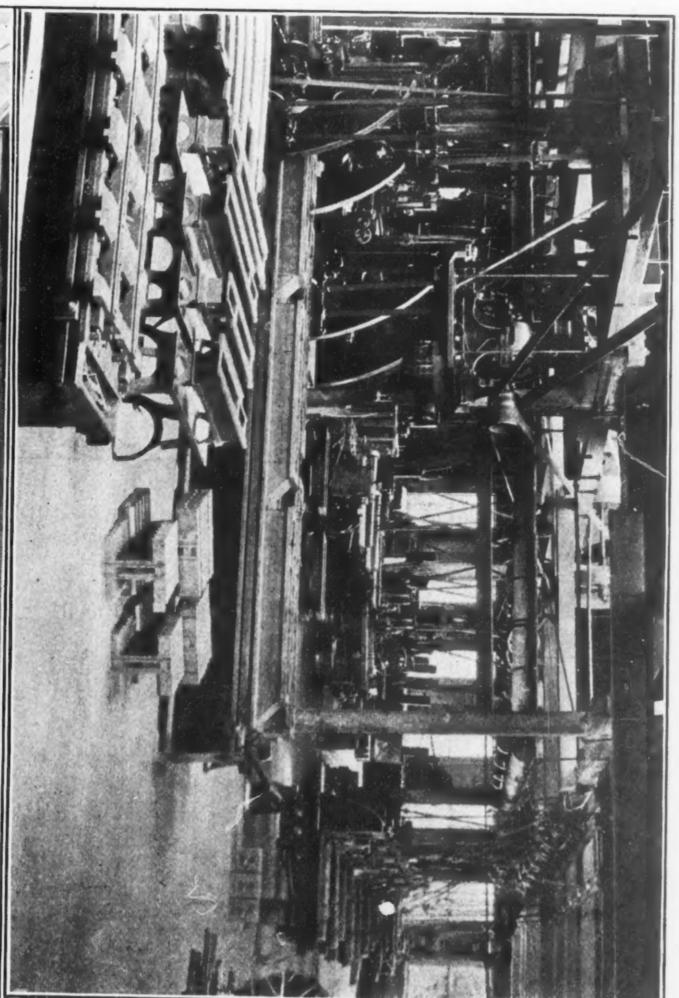
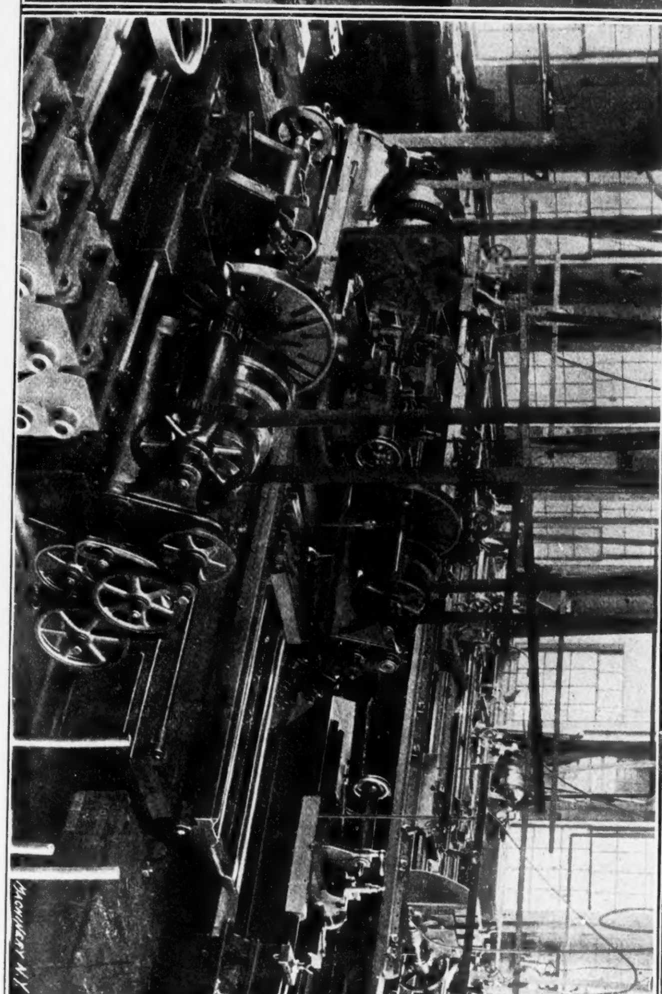


Fig. 7. Planer Department.—Note system of motor driving.
Fig. 8. The Foundry. Ridgeway Cranes in center.



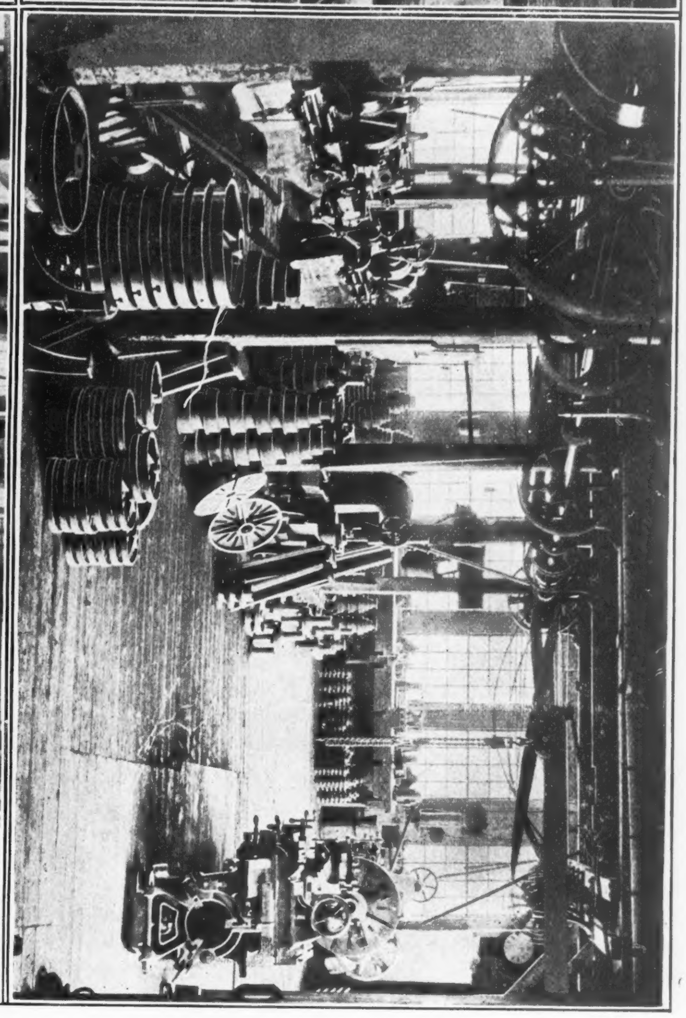


Fig. 9. Department for heavy Lathe and Turret work.
Fig. 10. Department for Turning, Threading and Splining Lead Screws.

After the headstocks are planed they are bored for the spindle bushes and the back gear shaft in a special machine. When a headstock is being bored it is held to a seat of the same shape as a lathe bed and is held in the same manner; that is, by four tap screws screwed into the holes provided for permanently holding it to the bed. In this manner the headstock is held under the same conditions as in actual use and the casting is de-

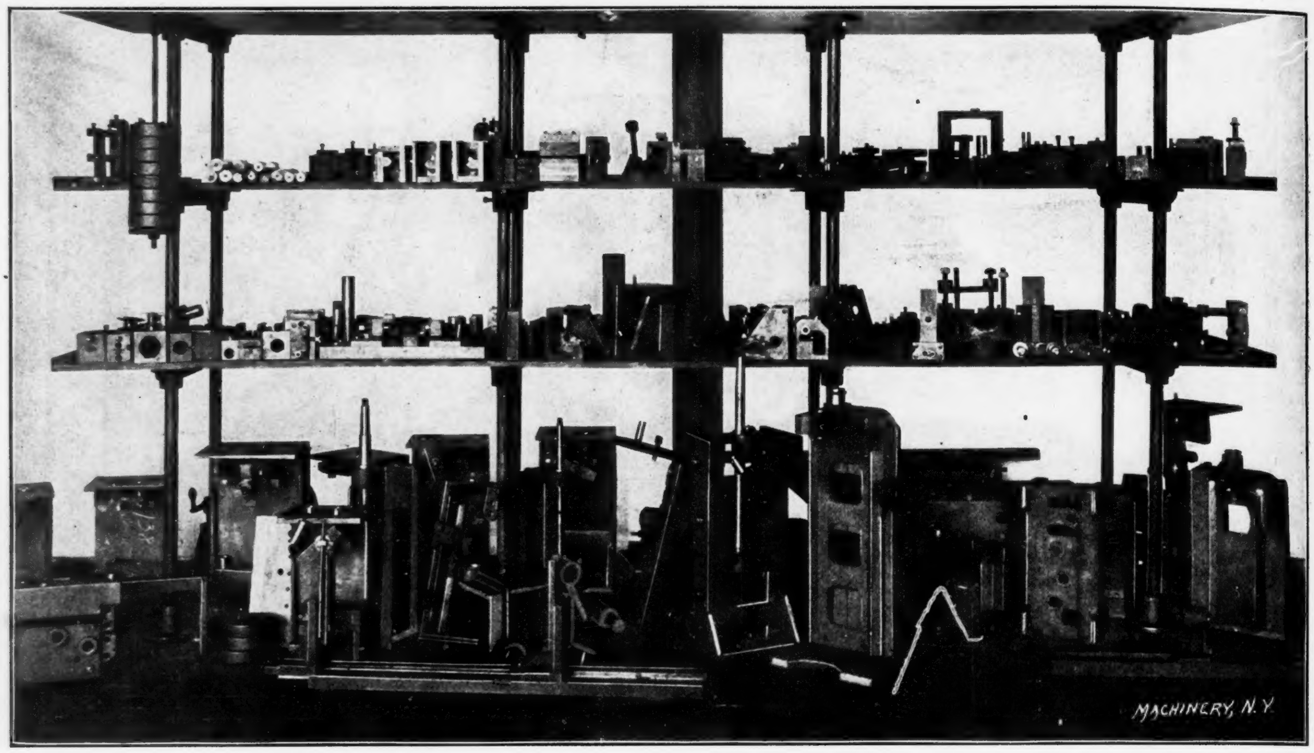


Fig. 11. A Group of Jigs used in the Hendey Shops.

flected in the same manner. The construction of the Hendey-Norton lathe readily allows of this method of procedure, since the headstock sets on one V-way and one flat way, and, therefore, little or no preliminary fitting is required to make each one seat properly. The machining and fitting of all important parts under the same phases that exist in working conditions seem to be the general practice. The lathe beds, when being scraped for the carriages, are fitted with a "dummy" headstock screwed

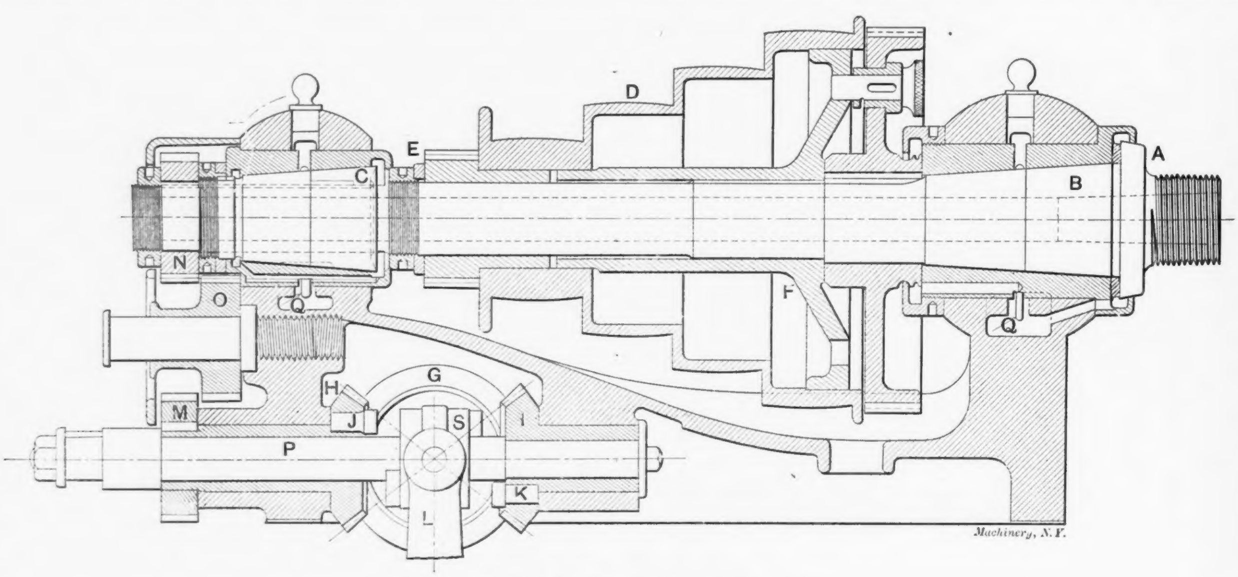
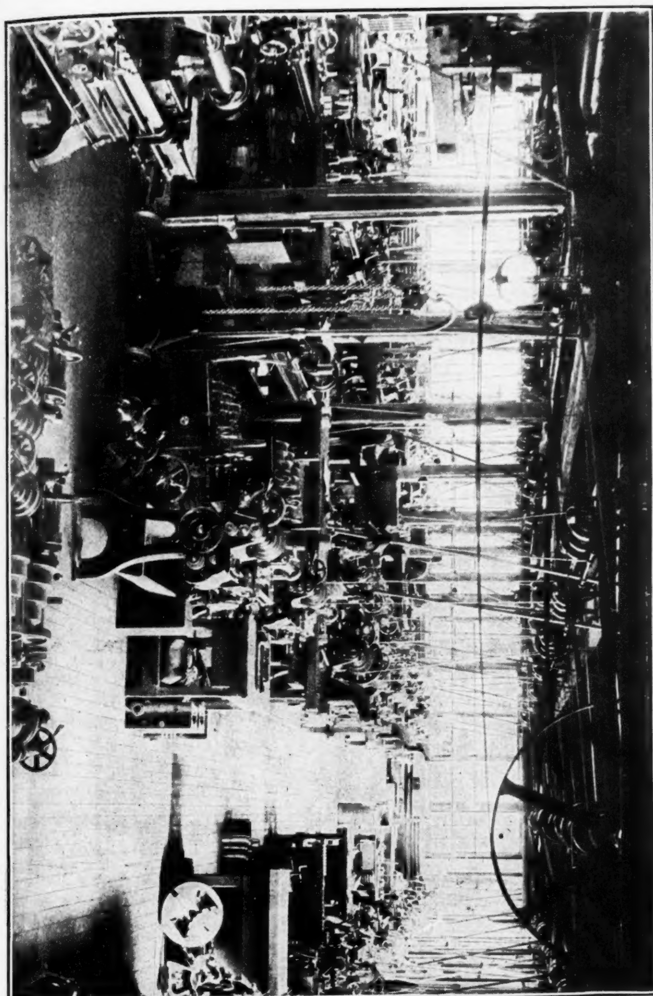


Fig 12. Headstock of the Hendey-Norton Lathe.

snugly in place, which thereby puts the bed under the same stress as when the working headstock is thereon. When the "dummy" is fastened in place the strain of the binding screws tends to turn the ends of the ways next the headstock slightly up, which effect must be corrected by hand scraping in order that the finished tool may meet the rigid requirements of the inspectors. It may also be stated that when a lathe bed is being scraped and fitted it is mounted on its permanent legs, and wedges are driven under them so as to level it perfectly and prevent any tendency of the bed to warp or twist.

In the construction of the carriage apron the planed top is made the working surface for the subsequent operations of drilling and milling. The top is first carefully scraped to a surface plate after being planed, so that it presents a true surface, and then, for instance, the grooves for the split nuts are milled on a Becker-Brainard vertical milling machine with the apron held to a knee on the table and bearing on the surface alluded to. The apron is made interchangeable for some of the smaller sizes of lathes, and for this purpose two sets of holes are tapped and drilled in the top for screws hold'ng it to the carriage. These little schemes for saving the duplication of practically the same parts on machines of slightly different sizes are not without their seeming disadvantages, apparently, when they are inspected by foreign buyers totally ignorant of modern American practice. One lathe sent to fill a foreign order was rejected because the buyer alleged that a mistake must have been made in its construction, since there were tap holes in the top of the apron for which there were no corresponding screws!

Jigs for all parts of the headstocks, apron, carriages, tailstocks,



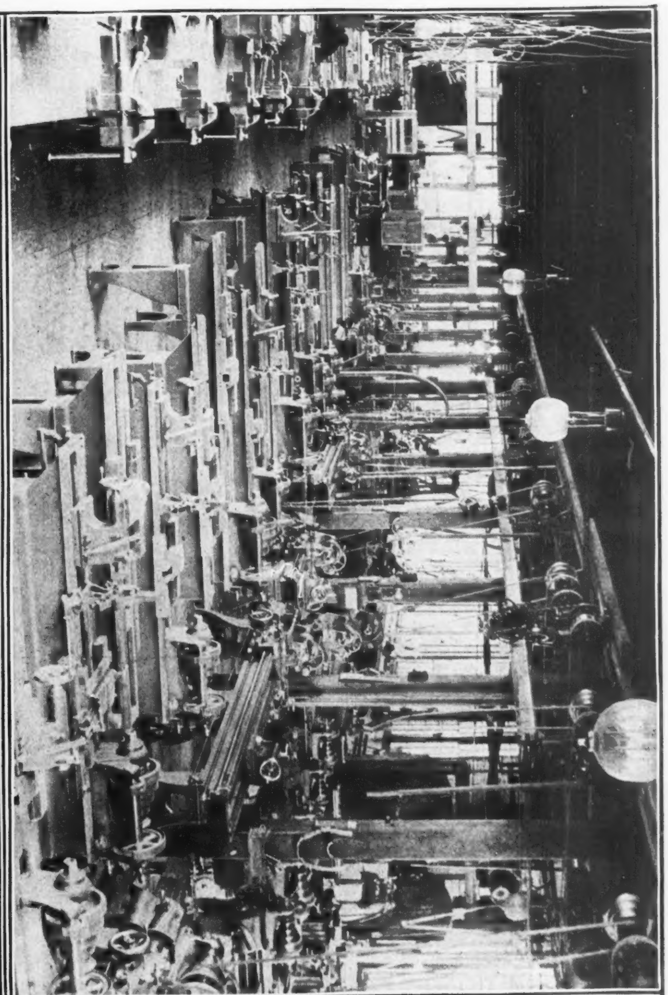
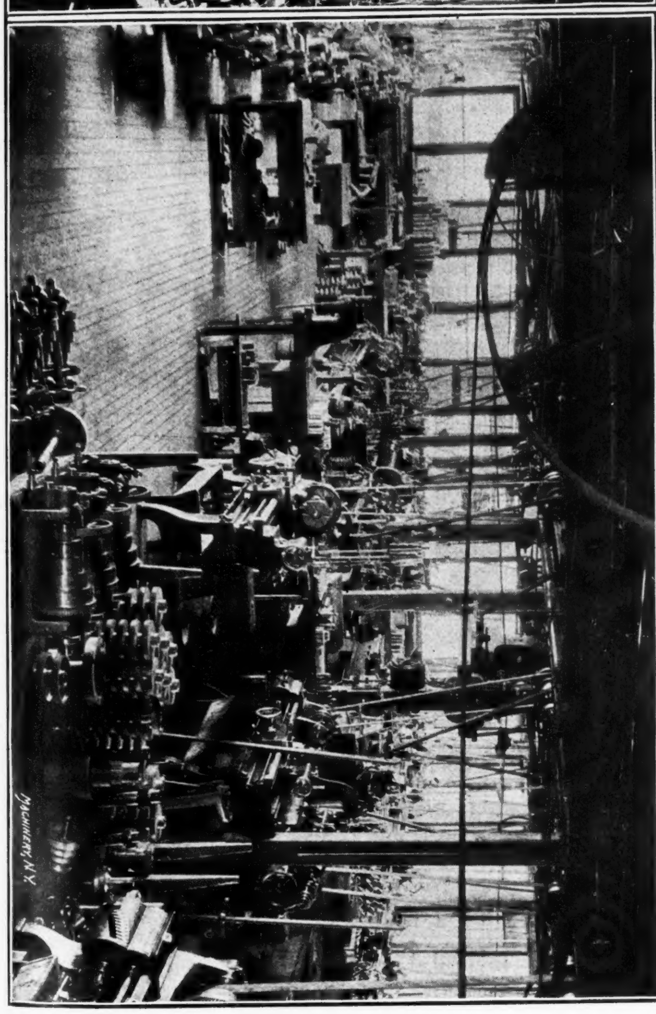


Fig. 13. View of front half of Lathe Assembling Department.
Fig. 14. One end of the Lathe Turning Department.



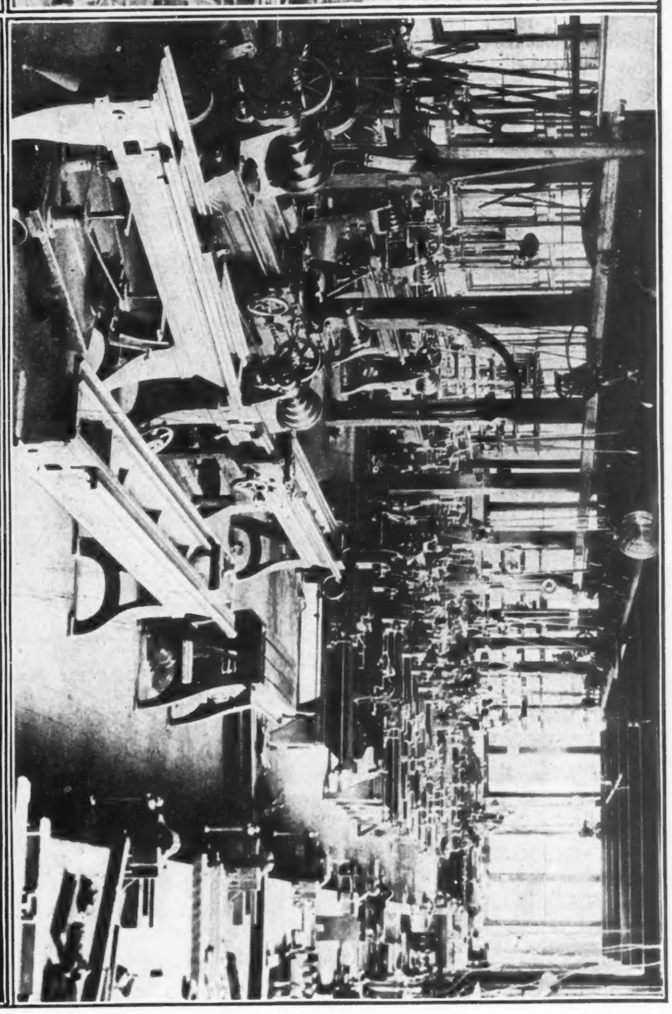


Fig. 15. Second half of Lathe Assembling Department. Truck for transporting Lathes in foreground.
Fig. 16. Another corner of Lathe Assembling Department.

etc., are very much in evidence. The illustration on page 36 gives an idea of a few used in one department. The use of these jigs insures accuracy and interchangeability of parts, two necessary conditions to be realized with the methods followed in the erection of tools in these works, since there is in general no fitting of one part to another before the machine is generally assembled, except in its component parts, such as headstocks, gear boxes, aprons, etc.

In the construction of the gear boxes a practical problem in fitting is met in a very simple and practical manner, and that is the meshing of the tumbler gear shown in Fig. 5 with the change gears mounted on a common shaft. It is essential that the tumbler mesh with each gear of the series to the proper depth, as can be readily understood, but the location of the in-

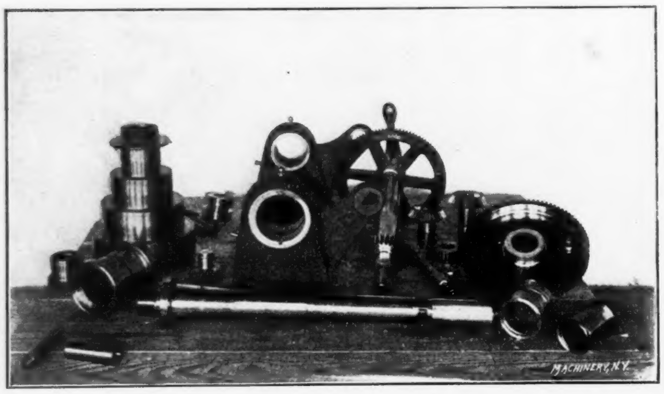


Fig. 17. Headstock of Hendey-Norton Lathe, unassembled.

dex holes along the outside of the gear box, so that when the plunger is entered into each of them this condition shall be realized, does not appear to be susceptible of being performed mechanically in any jig without some preliminary hand work, as there must enter the intelligent element of feeling the action, which is impracticable to incorporate in a shop jig. The practical method of overcoming this difficulty is to have an expert fitter take each gear box and assemble it in working order and then file the bottoms of the slots in which the tumbler lever fits until the tumbler gear will mesh properly with each one of the change gears. After this is done the holes for the index pin are drilled, the tumbler handle being used as its own jig for each hole. The gear box is held on centers and turned on the axis of the tumbler shaft to bring each hole under the drill and make the plunger hole radial with the tumbler shaft axis. It might also be mentioned that the outside of the gear box, where the

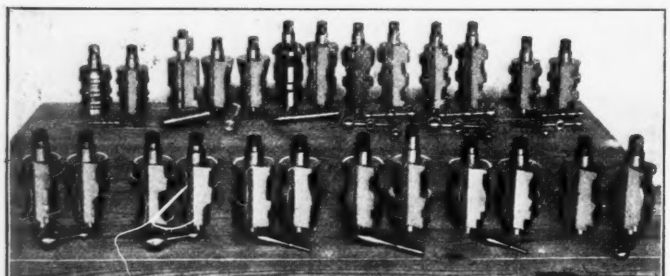


Fig. 18. Cutters used on Special Forming Lathe, with their Products.

index holes are located, is finished by grinding on the same centers with a Brown & Sharpe grinder of the planer type.

On the metric lathes, the usual compound or translating gears have been abandoned, the gear box having been designed especially for the metric system. The mechanical arrangement has not been materially changed except in the pitch of the lead screw and the size and arrangement of the change gears. The system of metric pitches adopted is that recommended by the Societe d'Encouragement pour l'Industrie Nationale, but it also includes practically all those in use by the principal shops throughout France.

The inside of all lathe cone pulleys is turned concentric with the exterior to insure perfect balance when running at high speed. This work is done on the Gisholt turret lathes which occupy one corner of the department and which are shown in Fig. 9 on page 35. The gear R and combined sleeve and head F shown in section in Fig. 12, are forced into the cone pulley by the hydraulic press illustrated in Fig. 6. The part F is turned all over so that all parts of the assembled cone are distributed symmetrically with reference to the axis, and perfect balance is thereby insured. Figs. 12. and 17 which shows the parts unassembled, give a very good idea of the headstock construction and the operation of the reversing device for the lead screw. Gears M and N are of the same diameter, and M is driven through the intermediate gear O, which in the cut is shown pushed towards the headstock and out of mesh. The gear M is keyed on a sleeve which carries at the other end the bevel gear H. Meshing with this bevel gear is the gear G which in turn drives the bevel I, but in opposite direction to H. Gears H and I each carry an abutment in the shape of the pins J and K, either of which may engage with corresponding pins on the sleeve S. This sleeve is splined on the shaft P and can be engaged with either of the gears H or I by shifting the lever L. Shaft P carries on its outer end a gear driving the lead-screw through the intermediate gears of the gear box. It is thus apparent that the action of the lathe spindle is duplicated by the shaft P, and if the action be interrupted it will again be taken at the same point.

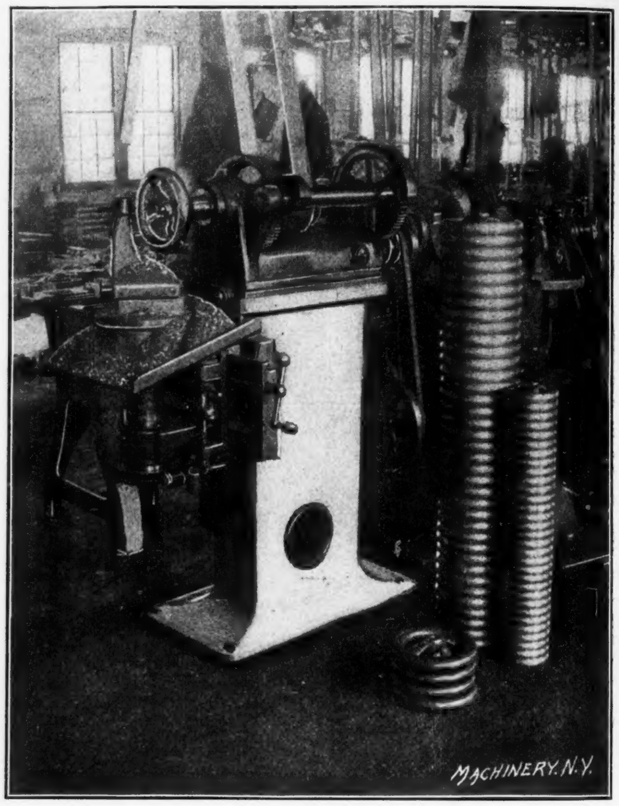


Fig. 19. Hand-wheel Turning Machine.

In this way there can be no failure of the threading tool to engage properly with a lead already started.

The various handles used on the lathes and shapers are turned from the bar on a special forming lathe of Mr. Norton's design, which gives eight spindle speeds without shifting the belts. This is effected by a two-speed countershaft driving an auxiliary spindle in the headstock, which in turn drives the main spindle through a nest of four gears arranged similarly to the standard gear box and changed by a lever in the same manner. The chuck is fitted with split sleeve collets for the different diameters of stocks and is so devised that changes to different sizes can be made very quickly. The forming cutters are used in pairs, being set diametrically opposite, so there is no lifting effect on the work. The cutters are steel cylinders, as shown in Fig. 18, with a cutting edge, formed by a longitudinal groove. Sharpening does not alter their form, and the life of a pair must be long, since the cutting edge can be carried nearly around the circle. It will be noticed from the illustration that the pairs of cutters are not alike, but that the shape of each is such that each cutter operates on a different section from the other. This prevents chattering, and probably also makes the

power requirement less. In turning handles the operator's attention is principally devoted to cutting them off and rounding the ends, as the forming action is practically automatic.

The hand-wheel turning machine shown in Fig. 19 is a combination of the frame of a Hendey shaper, on which is mounted the headstock of a Hendey-Norton lathe. The table is provided with a circular motion, which causes the tool to follow the contour of the rim. In turning rims the practice is to take a roughing cut and then remove the roughing tool for the finishing tool, which is provided with a stop gage bearing against the tool post. The operator pushes the tool in until the gage bears, and then secures it. The size is thus obtained for each wheel without measurement until it becomes necessary to grind the finishing tool, when, of course, the gage on the tool must be readjusted.

That important part of a lathe—the spindle—receives its full share of attention in these shops. The material used is a fine

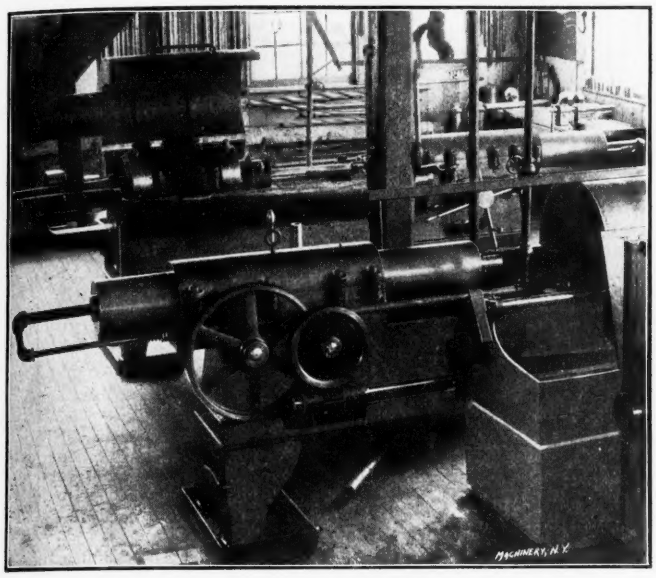


Fig. 20. Horizontal Drilling Machine for Drilling Lathe Spindles, etc.

quality of steel and no pains apparently are spared in getting each one as near perfection as possible. The rough stock is first drilled on the special horizontal drilling machines seen in Fig. 20, which are powerful and rapid tools. They are used in connection with oil-tube drills, the oil being forced through the drill spindle as seen in the foreground. One of these machines built for another firm has a record of 32 in. depth in mild steel in one hour when drilling a 3½-in. hole, which means the removal of over 300 cubic inches of solid steel. The spindles, after being drilled and reamed, are fitted with centered steel plugs for the subsequent operations of turning, threading and grinding. A convenient truck for transporting them to and from the grinding departments is shown in Fig. 21. This prevents any jamming or bruising and allows any spindle to be removed without disturbing the others.

When the spindle is mounted on its headstock and is all completed except boring the taper hole for the live center, the headstock is taken to a lathe having none and mounted thereon. The taper hole is bored with the tool guided with a Slate taper attachment, which method insures the holes being of the same taper and concentric with the axis. The feature of having one V-way and one flat way, as already pointed out, makes these operations very simple and accurate in results.

The lead screws are turned, threaded and splined in the same department, Fig. 10. As the lathes are arranged, a lead screw of almost any length can be cut. When cutting a lead screw the effort is to keep the temperature of the screw being cut and the screw of the lathe the same. If these conditions are realized, the generated screw is bound to be a faithful reproduction of the master screw. A blast of compressed air is directed against the threading tool throughout the cut, and this together with the excellent lubricant used has the effect of keeping the screw at very little, if any, above the normal temperature of the room. So little is the expansion that it is unnecessary to slack back the tail center even on the longest screws. The working test employed by the men to find if the temperature of the two screws is keeping about the same is simply that of feeling of each in turn, but it has been found to be a reliable guide.

The lead screws of all the lead screw lathes are renewed once a year, a master screw being kept for the sole purpose of making new screws. To facilitate their removal, they are made shorter than an ordinary screw for the same length of lathe, the extra length being made up by a permanent lead screw end, with a socket into which the new screw end fits. A pin binds the two parts together like one solid piece.

The split nut for the lead screw of the Hendey-Norton lathe is babbitted for the thread bearing. The split nut parts are clamped together around a threaded mandrel of the same pitch as the lead screw which is mounted in the machine so that it can be turned by power. In this position the babbitt is poured around the mandrel, and then as soon as it has set—before it is cold—the machine is set in motion and the mandrel unscrewed in a fraction of the time that would be consumed if done by hand. The nut is then sawed apart and relieved, to allow it to open and close readily on the screw. A noticeable feature of the split nut used on a Hendey-Norton lathe is its length, a feature which causes it to embrace many threads of the screw and tends to equalize any slight local inaccuracy.

A splining machine for splining lead screws is visible in Fig. 10, being the one on the right having a traveling head with a vertical slide which carries a horizontal spindle. The spindle carries the milling cutter at one end and the large driving gear at the other. An air pipe is visible, which leads a cooling current of air against the cutter, blows away the chips, and tends to prevent the lead screw from being distorted by heating. The screw is then clamped in the V-groove of the horizontal piece and is held in position for splining by the clamps shown.

The racks for all the lathes are cut on automatic rack-cutting machines of special design, which have a capacity of eight of the smaller ones at once. The rack-cutting machines are in the milling department, illustrated on page 41. Automatic gear cutters of various makes are also included in the milling department, and among them was noticed one of the first Fellows gear shapers.

A very convenient truck for carrying lathes about the shop can be seen in the foreground of Fig. 15, on page 37. The feature of the truck is the three elevating screws at the two back corners and at the front end. The screws are splined to prevent them from turning, and each is fitted with a revolving nut whose exterior is milled with sprocket teeth of the standard bicycle chain pitch. The forward nut has a bevel gear fastened to its lower face, and gearing with the bevel wheel is a bevel pinion. The pinion is mounted on a shaft having its outer end squared for the reception of a crank. Parallel with and below this shaft is another, which has a spur gear on its further end which meshes with a pinion of smaller diameter mounted on the shaft first mentioned. In use the truck is run under the lathe bed and two bars of flat iron are placed beneath it, against which the elevated screws bear. The weight of the lathe is taken off the floor by turning the screws by the handle on the shaft first mentioned. When the bed has been carried to the place

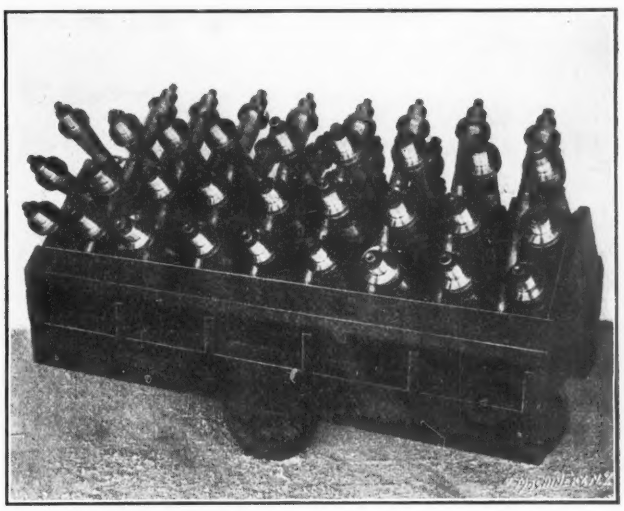


Fig. 21. Truck for carrying Lathe Spindles to and from the Grinding Room

wanted it is quickly lowered by putting the handle on the squared end of the other gear shaft, which turns the nuts with a higher velocity ratio.

The shaper department is supplied with a small traveling bridge overhead for transporting the machines and parts. The same essential methods of manufacture are followed in the construction of the Hendey shapers as of the lathes and the same general methods of inspection. The ram is tested for parallelism with the table throughout its full stroke; the table is tested for the various points in its cross and vertical travel; and the vise is also tested for these positions and in a number of angular positions. All tests are made with the Bath indicator, and limits of less than one-thousandth of an inch are set for the variations in accuracy. There is, however, not much satisfaction in building a machine like a shaper to such close limits, as it will almost invariably wear in a short time, so that such original refinement is of little value. The policy is, however, to make the machines as nearly accurate as possible, which, being ceived were due to neglecting some one of the almost obviously necessary conditions in setting up their tools that are specified in the memoranda.

The results of the tests for accuracy are given on the opposite page of the test sheet, and four views are given on the opening page showing the actual working methods pursued, which speak for themselves. Bath indicators are used for nearly all tests, all readings being taken in ten thousandths. Each lathe is run for a period of time that will demonstrate the bearings to be free and in proper condition. One of the tests to demonstrate this is to run the spindle for some time with a heavy end-pressure, a chunk of lead or babbitt being held between the centers and the tail center screwed against it with considerable force.

The 14-in. lathes are built in lots of 100, the 16-in. lathes in lots of 60, and the other sizes in lots of 30. The beds are made to order for whatever length required, but the headstocks, etc., are kept in stock. The cost charges for the other parts are divided into the divisions of carriages, aprons, headstocks, tail

Tests made in thousands of an inch with Bath Indicator with lathe belted and in actual operation.

Lathe properly leveled	X
Carriage moves freely and smoothly the entire length of the bed	X
Cross slide the same	X
Compound rest the same	X
Both lateral and cross feed frictions clamp and unclamp properly	X
Both feeds drive a strong cut	X
Clamp for carriage holds the same firmly	X
Carriage has a good bearing on ways of bed	X
Automatic stop operates properly	X
Head spindle cone and back gears run smoothly and freely	X
All oil holes and oil devices are in good condition	X
Tail spindle runs out and in smoothly and properly	X
Tail block clamps and unclamps properly and moves freely up and down the bed	X
Set-over screws work properly	X
The gears at end of lathe are adjusted and interchange freely	X
Gears in gear box with operating handle work properly	X
Index attached in place	X
The half nuts operate properly and are a good fit on lead screw	X
Lead screw runs true and free without back lash or end motion at thrust	X

LATHE SPINDLE

Tested for alignment with bar 12" long fitting firmly in taper of lathe spindle.

Alignment up in 12"		1		
" down in 12"				
" to back in 12"		1/4		
" to front in 12"				
Turns in 12" with sharp tool and light chip on machine steel on bar in spindle	Large at end			
	Small at end	front 1/2		
Tail spindle points when out full length	In	0		
	Out	0		
	Up	1		
	Down			
		1	2	3
Tail spindle aligns with head spindle 3 positions on bed	Up			
	Down	1	1½	2
Spindle and face plate align with cross slide tested by actual turning and facing of large face plate. When finished the plate is	Convex	0		
	Concave	0		
	Out	True		
Taper hole in spindle runs		X		
" " " bushing "		X		
End motion of spindle runs		X		
Taper attachment tested for alignment when at O		X		
Turns straight		X		

Date of inspection June 22nd

Inspected by Julius Millott Shop Inspector.

Endorsed by L. Ruot. Chief Inspector.

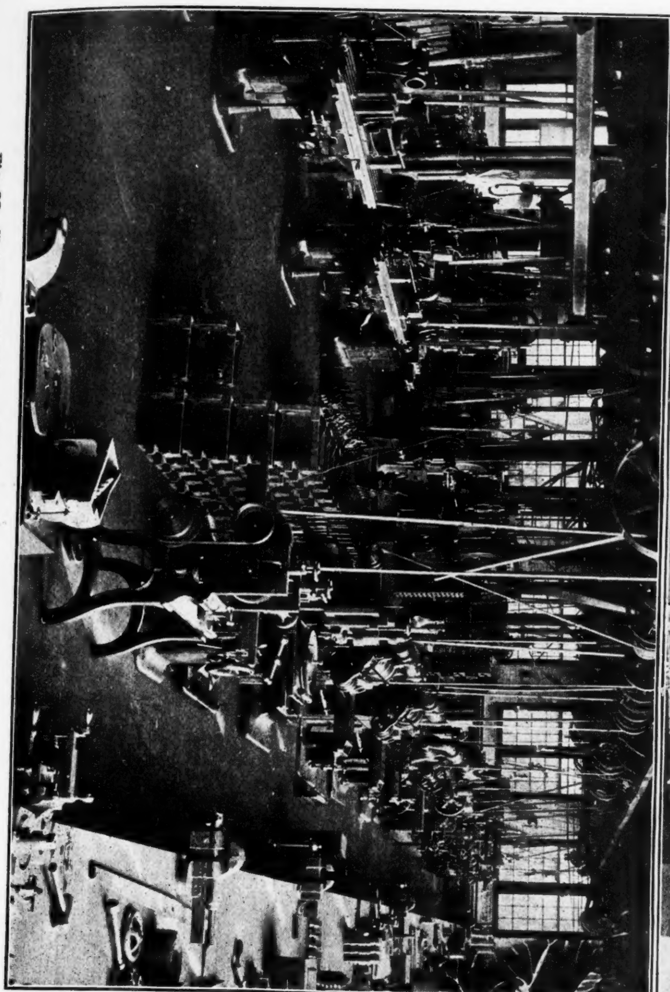
Fig. 22. Memoranda of tests made on Hendey-Norton Lathe No. 3875, size 14 in. x 6 ft. Readings in thousandths of an inch.

their original condition, throws the onus of future developed inaccuracy where it must be borne without complaint.

A copy of the memoranda of tests required for every lathe is given on this page. The one given is a copy of the record for engine lathe No. 3875, size 14 in. x 6 ft. This memoranda or a copy is sent with each lathe and furnishes the purchaser with not only a record of the inspector's tests, but with some valuable hints that he must not fail to observe if corroborative tests are to be made. Thus the first item is: "Lathe properly leveled," with a cross marked opposite. Such an injunction is, of course, not needed by the inspector, but he must certify to this condition, and the purchaser must also put the lathe in such a condition before he can consistently begin a test. In fact, the gist of part of the first page of the memoranda is simply a broad hint to the purchaser that he should put the lathe under proper conditions before it can be expected to produce mechanically perfect results. A long experience in the manufacture and sale of machine tools has demonstrated to the Hendey people that by far the greater number of complaints re- stocks, gear boxes, taper attachments, compound rests, and countershafts. The lead screws are made by the foot, as are also the racks. The whole system of cost-keeping is well worth a detailed account, but it cannot be well given within the limits of this general description.

A telephone system is in use, invented by one of the employes, that enables the officers and heads of departments to be called no matter where in the shops they may be, and without a central system. Each is designated by a combination of rings, which being heard by the person wanted, causes him to go to the instrument to answer his call.

The total output of shapers per year is about 400, while the capacity for lathes is 1,200. In the manufacture of practically these two lines of tools 460 men are constantly employed. The writer's impressions on the shop methods and the status of the men, both as mechanics and good citizens, were very favorable. While comparisons are generally odious, we think that the condition of the mechanic in Torrington will compare very favorably with that of mechanics in any other town in the East.



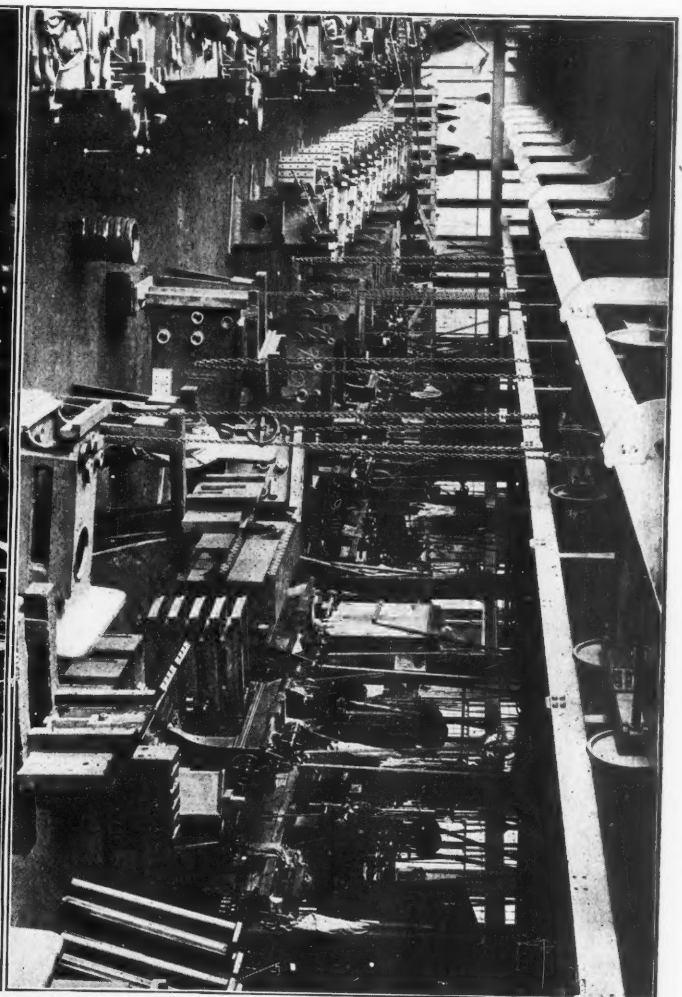
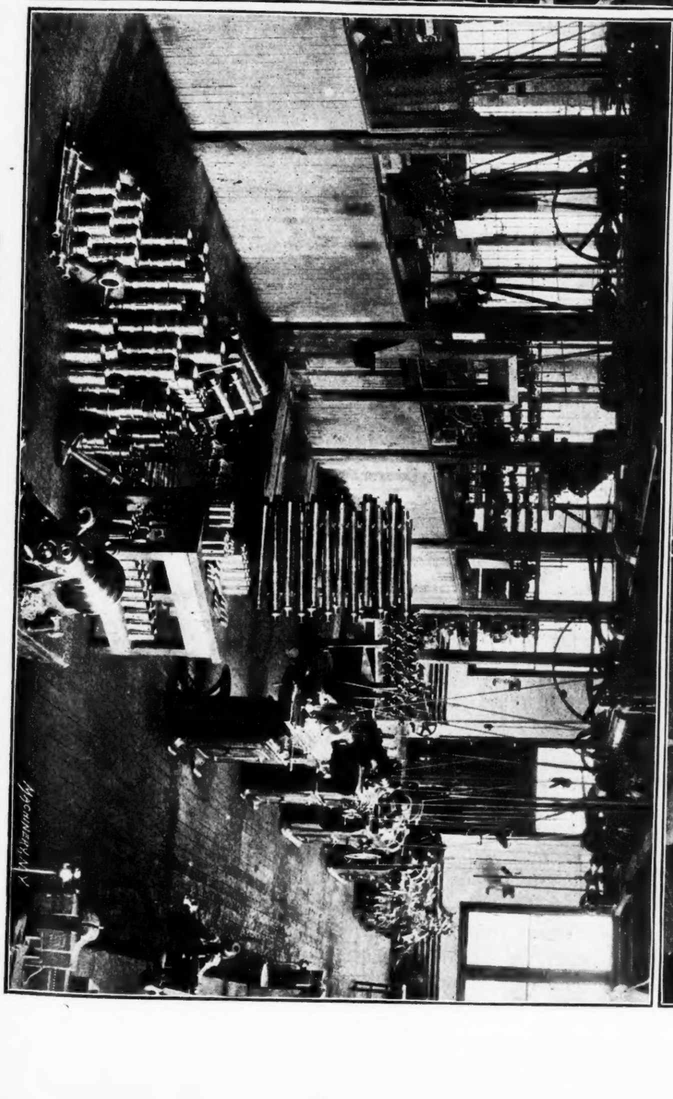


Fig. 23. Shaper Erecting Department.
Fig. 24. Milling Department. Gear and Rack-cutting Machines at the Rear.



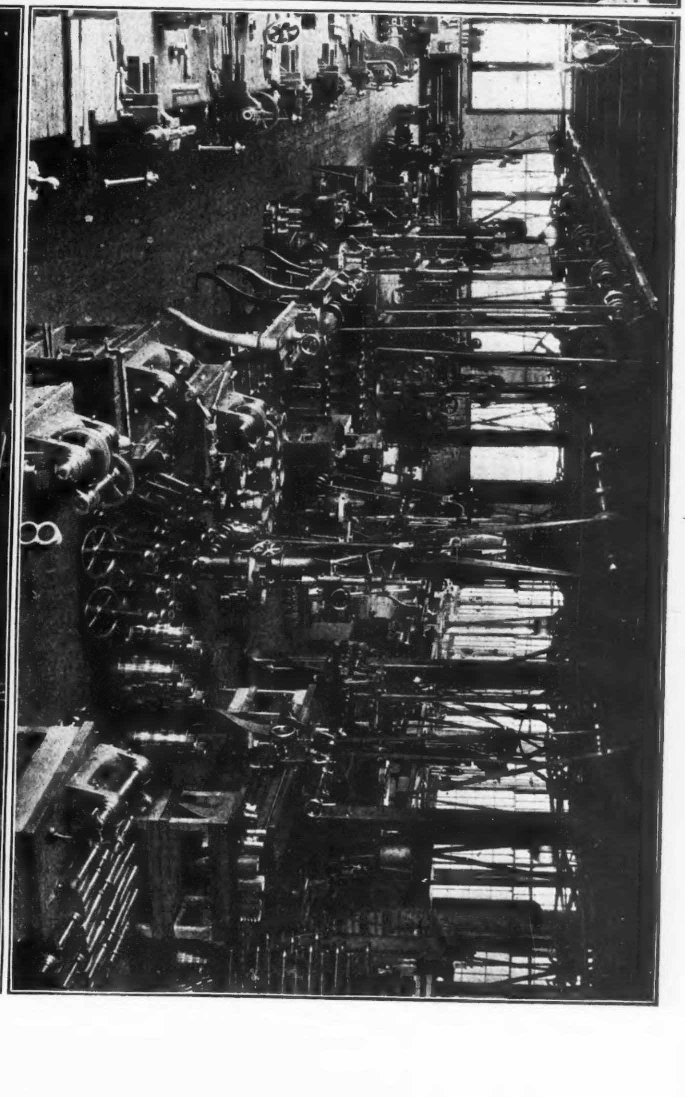


Fig. 25. Jig Drilling and Lathe Parts Assembling Department.
Fig. 26. Grinding Department and Corner of Tool Room.

A LETTER FROM ABROAD.

GERMAN SHOPS—THE EXPOSITION.

Editor MACHINERY:

An unexpectedly short sojourn in Paris, owing to a somewhat extended trip through Germany, Austria and Switzerland, has so far prevented the preparation of a detailed description of machine tools at the Exposition. It may, however, be of interest to your readers to see a brief account of my first impressions, from a mechanical point of view, of the Exposition in general, as well as of some machinery inspected in the other countries named above.

Whatever may be the financial aspects of the Paris Exposition, there is no question but that it is by far the largest and most beautiful exhibition the world has ever seen. In comparing it with the Chicago Exposition of 1893 we often hear the criticism that, being planted in the heart of a great city with many old buildings surrounding it and intertwined with it, so to speak, it is impossible to get the beautiful general effects that were secured at Chicago. It is true, perhaps, that there may not be at Paris any one spot having the grand and reposeful beauty of the Court of Honor, so-called, with its numerous lagoons and beautiful architectural surroundings. It is true that at Chicago there was a much better opportunity for landscape effect, a very large tract of ground by a beautiful lake being at hand for the architects and landscape artists to work their will upon—and nobly it was done. There are, however, in the Paris fair so very many beautiful places, and such admirable skill has been exercised in lining the river Seine on both sides with noble buildings which, though sometimes fantastic, are on the whole very artistic, that the view over the water at night, with everything brilliantly lighted, with the great tower pouring its revolving searchlights down upon the scene, is such that few more lovely scenes can dwell in one's memory.

The buildings here are so much more numerous, and many of them so much finer artistically, than in any fair that has ever been held, that nothing else in the exposition line can approach it in general outside beauty, to say nothing of the superior beauty of the inside, due to the vastly greater number of exhibits and their high character artistically. All this is not to be wondered at when we consider the vast expenditure that has been incurred, and the length of time that has been employed in producing the grand and lovely effects resulting. Much criticism has been indulged in regarding the lateness of completion, but it must be remembered that our last great fair in America was delayed a whole year in order that it might be somewhere near ready at the time finally fixed upon for the opening.

The greatest fault of the Paris "great show" is, in my opinion, the altogether mysterious and incomprehensible system of classification, which, though originally founded upon a scientific scheme of considerable merit, has resulted in a very curious mixture of exhibits which renders it extremely difficult to find what one wants to see, or to compare different exhibits of the same class, they being widely separated not only in different parts of the same building, but in buildings far removed from each other, many of them being at Vincennes, several miles away from the main Exposition. In order that the grouping scheme might be carried out with some degree of logic we get the result of coffee mills, milling machines and bicycles mixed up with medicine and silk dresses, and the writer was much surprised one day to find a magnificent exhibit of twist drills in the third story of a small detached building which seemed to be partly devoted to the promulgation of maize products in Europe, even to the extent of serving hominy, hoe-cake and delicious corn griddle-cakes as a free lunch to the few fortunate persons who happened to discover the little building in question.

On the whole, the machinery exhibits of the Exposition are excellent, but the machine tools made in Europe often show a lack of harmony in design, both artistically and kinetically, as well as a disproportion in the comparative strength of different parts which, to an American designer, are somewhat painful. These points, however, may be more fully considered in detail in a future letter. While in Berlin I had an opportunity to examine several of the larger manufactories for the production of machine tools, guns, electrical apparatus, etc., and was somewhat surprised at the large number of enormous and successful industries which are being carried on, or are being installed, in that city. It does not seem to me exactly true, as has so often been charged, that the German manufacturers are in the habit of buying one of each kind of some first-class American machine tool and then making inferior copies of it which exactly resemble it in outside appearance, but which are wretchedly made and put together. On the contrary, the Germans seem to buy a good many American tools to use rather than to copy, and this because the tools are so good that they cannot afford to do without them. It would also seem true, however, that they do not intend to import all their good tools, or, especially in the future, any very large portion of them. To avoid this they are, as has already been made known upon our side of the water, establishing great machine shops equipped largely with American machinery for the production of machine tools, which will be as good or better than ours in every sense of the word. These products, however, do not purport to be, nor are they, exact copies of ours. They seem rather to be of original design, founded largely, of course, upon our experience. This experience they gather to themselves in many cases in a perfectly legitimate way by employing high-class American designers, managers and superintendents. Whether these Americans will remain at the heads of the industries in question, and will be found there a dozen years hence, is of course as yet an open question. It seems to me that they are not likely to cut loose entirely from America as a source of supply for mechanical ideas, inasmuch as the engineers of our nation have been for two or three generations past developing in a big way the matter of original design of the simplest possible character. It would seem, indeed, that our specialty in designing is going straight to the point aimed at, regardless of precedent, so as to accomplish a result with the fewest possible motions, the fewest members and the fewest pieces in each member. Moreover, our faculty for simplifying the shapes of the pieces and adapting them to the particular jigs and other special tools which are to produce them cheaply is something that all Europe must take advantage of if she would compete with us in building machinery.

All these things are found in some of the magnificent factories in Berlin, with the result in products which might be expected. In one of these, devoted to the production of electrical machinery, there is one vast room practically without belting or shafting, being of an L shape, having wings about 700 feet and 400 feet long, respectively, the width of each being perhaps half as much. This is lighted chiefly by skylights, and has a gallery most of the way around, much in the American fashion, which, by the way, may perhaps not be so American after all, as we too are very apt to copy good things we see abroad. In one of these large manufactories a completely equipped underground electric railway nearly a quarter of a mile long connects different parts of the premises, and everything is of the most stable and solid construction in the way of buildings and general equipment. The whole force of workmen employed in these and some of their other smaller shops is about 14,000.

In such factories the workmen seem happy and contented, earning about six marks (or $1.50) per day, and apparently enjoying the clean, well-lighted shops and the admirable arrangements for bathing, washing and keeping their clothes in individual lockers as good as those found in many gentlemen's country clubs. I am informed that strikes among these workmen are entirely unknown.

Among other places visited in this city was the National Mint, which is not so very different from those in America, except that the rolling is done with much smaller and lighter mills, and much of the coin milling (rimming the edges) is done on horizontal rather than vertical machines. The coining presses run about as fast as ours at home and produce as good work, but they are unnecessarily complicated and occupy a great deal of floor room. Some of them date back over half a century, but appear to be running in good order still.

A curious feature of Berlin factories is that many of the great shops are in the rear of handsome business buildings on the main streets of the city, only a few of the newer ones being placed in the suburbs. Among these latter are the great "German Niles" Works, which are some distance out of town, upon the banks of the Spree.

In Dresden, the next city visited, the manufacturing is mostly

done outside of the town, and does not seem to include machine tools to much extent.

The same may be said of Prague and Vienna, where, however, but comparatively little work of this kind is done. In the latter city the mint is run upon much the same lines as in Berlin, and seems to be very capably managed. The same small rolling machinery is used, with the result, I think, of far less uniformity in the thickness of metal than can be obtained by our heavier American rollers, or by the still heavier ones which ought to be, but are not yet, used. The result of this unevenness is necessarily that more weighing, sorting and scraping of "planchets" is required, together with a greater number of light ones rejected for remelting. All such work, however, is done in automatic weighing machines and in power scraping machines, rather than by hand with files as is so much the practice in America. In this respect the older countries are certainly ahead of us.

In the Vienna mint the coining presses are in some cases still larger and more unnecessarily complicated than the ones before referred to. Some of these machines are dated as early as 1817. In many of them the old swinging ram (still used in America) for carrying the upper coining dies has been abandoned in favor of a sliding ram,—as, of course, should be the practice in all cases. Some of the older machines seem to have been rebuilt, with new sliding rams substituted for the original ones of the other type.

In the principal cities of Switzerland but comparatively little manufacturing of machine tools is done, but in regard to the extent and quality of such work the writer has not had an opportunity to judge personally. At manufactories in Geneva for the production, respectively, of electrical machinery and of stamped ware of silver and other metals, the writer noticed some very good American machinery. The electrical shop buildings were built and equipped in the best modern style, much resembling some of our own of the newest fashion.

A return to Paris, for a somewhat lengthy sojourn, is now affording an opportunity for a more careful examination of the machinery of the Exposition, upon which comment may perhaps be profitably made at a later date.

OBERLIN SMITH.

* * *

CREEPING RAILS.

The rails on the double track line running across the Eads bridge over the Mississippi river at St. Louis, Mo., give trouble by creeping to an unusual extent, which fact has been a matter of observation for many years. This appears to be due to the flexibility of the bridge, which takes on a wave-like motion when a train passes over it, causing the track to move slightly under the forward motion of the train. The bridge proper has a rise of 5 feet at the center of its length of 1,600 feet. The east approach is on a curve and is a steel viaduct 2,500 feet long, and here the creeping was excessive until the viaduct was rebuilt in a more substantial manner. The west approach is an embankment, and the track upon it gives little or no trouble. The force exerted by the creeping rails is sufficient to fracture splice-bars and ⅞-in. bolts, and to drive a 70-lb. rail round a curve of 5¾°, and straighten it again on the tangent beyond. Means are provided to allow the rails to creep without injury to the track or the structure. At each end of the bridge proper is a double crossover, and as these must be maintained permanently in position special creeping devices have been established. There are eight sets of these devices, four in each track. They are situated at the east end of the east approach viaduct, at both ends of the crossovers on the east side of the bridge, and at the east end of the crossover on the west side. At each of these places two switch rails are placed in the track, and the main rails pass outside of these switch rails, which are firmly anchored to steel plates on the ties, and have guard rails with a flange-way of 2 in. When a main rail has nearly pulled past the switch rail another is coupled on to it; while a rail that has pushed through is uncoupled and taken back to the other end of the section, where it is again put in the track.

The "Engineering News," from which these particulars are taken, publishes a table showing the extent of the creeping during the past year. The greatest distances recorded are 42 feet in one month for one of the rails on the bridge and 57 feet in one month for one of the rails on the approach.

COST SYSTEM FOR CONSTRUCTION AND REPAIR DEPARTMENT.

W. E. HOPTON.

During the past two years numerous articles have appeared in the technical press on the subject of "The Finding and Keeping of Shop Costs."

These articles have dealt entirely with the cost of production of staple machines, articles, etc., and explained the various systems devised to show the true profit or loss and to furnish a foundation on which to estimate for the future. These systems are very effective and often result in a saving of cost in bookkeeping.

Competition is too keen to admit of waste of time and material and requires not only the quality of work to be brought to, and maintained at, a high standard, but that the appliances for doing this work be kept in their most efficient state. The cost to do the latter often forms a considerable percentage of the total cost of production.

Then, too, the repairs on a certain machine may be such, from year to year, as to make the purchase of a modern machine more adapted to the work imposed, a good investment.

In factories or plants manufacturing chemicals, oil, soap, paper and the like, the repair item is necessarily large, due to the wear and tear of the processes of manufacture. Some system is necessary to keep proper account of this cost, and the relation between maintenance and repair, without involving much clerical labor. Practically all shop cost systems rely on the "Card Index," which consists of cards printed in a suitable manner, filed in boxes or drawers under a suitable index. The system to be used for "cost of repairs" must be on this plan or a similar method. The repair department may, at times, attend to new construction about the plant on machines, piping, etc., either as a necessity or to furnish work between times of repair. This item must then be kept separately from that of repairs, as it adds to the value of the plant.

Many of us who have given the subject attention would doubtless agree on a standard method to do this work, based on perfect conditions. When we turn, however, to our separate lines of business to make the adaptation, we find that the system adopted, while resembling the standard, is much changed to suit our particular conditions. The writer had occasion, several years ago, to devise a system for the repair and construction department of Colgate & Co.'s factory, with which he is connected. This system is in force to-day, unchanged in general principles, but more fully developed and extended in details.

The feature of the system is to carry the items of cost of repair and construction to a point where but little labor would be required to ascertain the whole cost, if necessary, at any desired time; but this is not done generally, except at the end of the year. The starting point is with the time card, shown in Fig. 1,

Time Card, Colgate & Company.

Date..................................

		Hours.
Laundry.		
Raw Stock.		
Soap Powder		
	Total	

Name........ ....

Fig. 1. (The actual time-card has ten spaces, one for each department of the factory.)

which is given to each workman to fill out in the space, or spaces, for the particular departments for which he has worked during the day. This card he is to deposit at the office as he leaves the factory at night.

The next day the time cards are looked over by the head of the

department to note correctness of the same, and to mark the items of new work by the number under which the work is designated. All new work or improvements have numbers, to which all time and material are charged. It was found too complex to have the men charge to the number direct and to make the nice distinctions that are often necessary, so the above plan was adopted.

The time cards are then transferred to the "Construction Book," where all labor on new work and repairs is entered. No attempt is made to keep the individual account of each man's time, but instead a division is made according to the trades.

The wages of the men are reduced to a basis of ten cents an hour; for instance, if a man receives three dollars per day of ten hours, his rate is thirty cents an hour or on the new basis for a day of thirty hours at ten cents an hour. A portion of a page of the "Construction Book" is shown in Fig. 2. The spaces devoted to the departments can be as many as there are departments in the factory using this system.

Cost of Construction for Week Ending....................

	LAUNDRY.		RAW STOCK.	
	M T W T F S S	Amount	M T W T F S S	Amount
Machinists..........				
Pipe Fitters..........				
Blacksmith..........				
Carpenters..........				
Laborers..........				
Firemen..........				
Engineer..........				
M. E. Ass'ts..........				
Total Amt. Dept....				
Mech. Eng..........				
Extra Men..........				
Total Amount......				

Total Amount of Labor, Mech. Eng. Dept.. ....

Total Amount of Labor, Extra Men..............................

Total Amount of all Labor......................................

Fig. 2. (This is ruled up, and printed in book form with ten divisions, one for each department.)

The wages of the men are entered under the spaces devoted to the days of the week as so many hours whose basis is ten cents to save figures and time. The amount for the week is entered as so many dollars, that is, the total number of hours for each trade multiplied by ten.

The new work or improvement, which has previously been marked, as explained above, is then transferred to a sheet, as

No. / Subject................. / .... / Dept.	New Work.										
	Machinists.	Pipe Fitters.	Carpenters.	Blacksmith.	Laborers.	Draughtsman.	M.E. Assistant.		Amount Per Day.	Amount Per Week.	Amount Per Month.
....											
....											
....											
....											

Fig. 3.

shown by Fig. 3, on the same basis as in the "Construction Book." No provision is made for each week, because the demands for repairs may interfere with continuous work on the improvement, and so much so sometimes that a week or a month may elapse before the resumption of the work after the interruption. Columns are provided, it will be seen, for obtaining the amount for any day, week or month. When the work is finished the total labor cost is easily obtained.

Thus far we have the record of total labor for repairs and new work, and total labor for new work. The total labor for repairs is obtained by subtracting the latter from the former. These items are collected and entered on a weekly report blank, as shown by Fig. 4. This is done also for every month, three months and six months.

Labor Report of Mechanical Engineer.

Week ending......................

LAUNDRY.		LAUNDRY (Raw Stock).	
Labor..................	....	Labor..................	....
New Work............	....	New Work............	....
Repairs................	....	Repairs................	....
% of Total New Work..	....	% of Total New Work..	....
" " " Repairs.....	....	" " " Repairs.....	....

Total Labor............Total New Work............Total Repairs............

Per cent. Total New Work of Total Labor............

Per cent. Total Repairs of Total Labor................

Fig. 4. This blank also has a space for each department of the factory.

The above method gives us no record of the repairs on the separate machines unless we transfer from the time card. To avoid this there are separate slips for each department or group of machines, or piece of apparatus, depending on the need of repairs. These slips are similar to those shown by Figs. 5, 6 and 7, and are given to the workman to fill out with the time card, with which they are deposited at night. The next day the slips are looked over by the head of the department to see if the wording is sufficiently clear as to describe what was done, and so it could be understood several months afterwards.

Pumps.

Date........................ Dept........................

Kind of Pump..

No. " " ....

Use " " ....

PARTS PACKED. STYLE OF PACKING.

Valve Stem............ :..................................

Piston Rod Steam End......................................

" " Water End......................................

Piston " " ....

Repairs...

....

....

General Condition...

....

Time.................... Name..........................

Labor $ .... Supplies $............

Fig. 5.

The amount of cost of labor is entered at the bottom, and the slips are filed away on hooks in a closet built for the purpose. There is in each department a hook allotted for each important

Box and Printing Machinery.

Date............................ Kind............................

Press...

....

Planer..

....

Saws..

....

Nailers...

Repairs...

....

Remarks...

....

Time.......................... Name..........................

Labor $.............. Supplies $...........

Fig. 6.

machine and for general repairs. We have about one hundred and seventy-five hooks in our case. These slips remain on the hooks for reference at any time to see how often certain repairs are made, or what the cost may be for any definite time, by adding the amounts at the bottom of each slip.

So far we have dealt with labor only. To obtain the cost of supplies, we charge the particular work on the carbon copy of the requisition, when the original is made out. When the bills are sent in, the amount of each requisition is transferred to the carbon copy while checking them. The data, as regards the

Laundry (General).

Date.................... Material used.

Belts.	....
Floors.	....
Shafting.	....
Pipes.	....

Time................ Name................................

Labor $........... Supplies $...........

Fig. 7.

kind, quantity ordered, and cost in the case of new work or improvement is transferred to a book kept for the purpose under the number given to the work, and the data for repairs transferred to the slips in the place designated "supplies."

In the case of supplies that are ordered in large quantities, such as packing for engines, pumps and valves, and which are charged to a general account, the amount used each time is entered on the slip by the workman, with the time of labor.

When the slip is examined the cost of packing, etc., is duly entered. Where pipe and pipe fittings are used, if the quantity

Pipe and Pipe Fittings.

Work No................ ....Dept.

Date .... Cost..... .... Name................

KIND.	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6
Valves Gate......														
Valves Globe. ..														
Tees														
Ells.............														
Plugs														
Flange Unions...														
Unions														
Couplings........														
Bushings.........														
Caps.............														
Crosses														
45° Ells.........														
Y's..............														
Cocks............														
Pipe.............														
....														

Fig. 8.

is large, a slip, as shown by Fig. 8, is used, or when small on the slips shown by Figs. 5, 6 and 7. The cost is entered as in the case of packing.

There are, at present, eight slips of the general style, one shown by Fig. 5; five being like Fig. 6, and two like Fig. 7. The hooks in most cases will hold records for three or four years. If the records are removed, the summation for each year can be made on a separate slip and left on the hook. The slips removed are put away in boxes, easy of access, if necessary, for reference. The time cards, Fig. 1, need not be preserved after the time is transferred to the Construction Book, as the records are on the slips.

It does not cost over $400 a year to take care of the above system, which records an expenditure for repairs and new work of about $30,000 per year at the lowest for labor and supplies.

Many would doubtless improve on this arrangement in adapting it to their line of work. It has afforded the writer the means of locating the principal faults in the machines and apparatus, which, by frequency of repair, warranted changes to strengthen the defective parts or to remodel the machine to remove entirely the source of trouble. It has also enabled us to cut down our repair bills, and has saved us, at least, the amount yearly that it costs for clerical work to maintain it.

There are many leaks in the expense account of a large establishment that can be stopped by a system like the above.

* * *

Some recent experiments in regard to the decrease in the strength of iron after being pickled and galvanized are very interesting. A dozen eye-bolts, all precisely alike, were carefully selected. Six were laid on one side and the other six sent to be galvanized. Afterwards one of each of the ungalvanized bolts was connected to each of the galvanized ones. They were placed between two pieces of iron and the nuts screwed up until the eye-bolts broke. Invariably it was found that it was the galvanized eye-bolts that were the ones to break; not in one instance did the ungalvanized ones give way.—Jour. Am. Soc. Naval Eng.

* * *

THE FRENCH MARKET FOR CALIPERS AND GAGES.

The U. S. consul at Havre, France, sends a report relative to the market conditions in France for the sale of steel rules, caliper gages, graduated scales, etc., in which he states that the market is an open one, not being controlled by any particular house or syndicate.

There is, in his opinion, a good opportunity for the introduction into France of this class of American-made tools. Americans, with their extensive and practical knowledge and the improved methods they use in manufacturing their goods, should be able to command the lion's share of the trade.

The only competitors worthy of notice are the Germans, who, by their geographical position, their imitation of American patterns, and their ready adaptation to French requirements, have gained an important position in the French tool market. Americans, however—with their much greater mechanical ability, not to mention their up-to-date machinery and the cheapness of raw material in the United States—if they would show an equal readiness to comply with foreign requirements, would have very little difficulty in out-distancing their German rivals. Of course, the scales must, in every case, be metrical, as no other system of measurement is used in France.

To successfully create a foreign outlet for the sale of American goods the field must be carefully exploited. Manufacturers cannot expect to make satisfactory arrangements for opening up a trade by sending to the different consulates catalogues, price-lists, circulars, etc., printed in English, with a request to the consul to deliver the same to some of the principal local dealers. This only takes up the time of the consular officers and seldom does any good, as the books are generally thrown aside or go into the waste-paper basket.

If manufacturers want to open up a foreign trade they should send abroad intelligent representatives (those speaking the language of the country would have more chance of getting satisfactory results) to investigate the economic and industrial conditions of the market, with a view of either establishing agencies managed and run by their own people (which is by far the best) or of selecting local agents whose financial condition and moral character have been ascertained to be good.

* * *

The New York Ship Building Co., Camden, N. J., the buildings and shops for which are now being erected and equipped, will have one of the most complete plants in existence. As evidence of the elaborate scale upon which the plant is being constructed, a press item states that a series of glass and steel buildings is being erected which will be of sufficient size to enable four of the largest battleships to be erected simultaneously while completely under cover. The loss from the heat and rains in summer and the cold in winter is enormous when the work upon a vessel has to be done in the open, and while buildings like the ones referred to represent a large investment, they will undoubtedly net a good interest.

Entered at the Post-Office in New York City as Second-class Mail Matter.

MACHINERY

A practical journal for Machinists and Engineers, and for all who are interested in Machinery,

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

9-15 MURRAY STREET, NEW YORK CITY.

ONE DOLLAR A YEAR, POSTAGE PREPAID, TEN CENTS A COPY.
FOREIGN SUBSCRIPTIONS ONE DOLLAR AND FIFTY CENTS A YEAR.

Lester G. French, Editor.
Fred E. Rogers, Associate Editor.

The receipt of a subscription is acknowledged by sending the current issue. Remittances should be made to THE INDUSTRIAL PRESS, and not to the Editors. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Domestic trade is supplied by the American News Company or its branches.

We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

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UNITED KINGDOM.—Sampson Low, Marston & Co., St. Dunstan's House, Fleet Street, London, E.C.

OCTOBER, 1900.

CIRCULATION STATEMENT.

The regular edition of MACHINERY for October is 24,000 copies.

MACHINERY has the largest paid-in-advance circulation of any mechanical paper in the world. No subscriber is entered on our mailing list until his subscription is paid for, and all subscriptions are stopped at expiration. Except on special quarterly numbers, no papers are sent free other than to advertisers, exchanges and circulation agents. AMERICAN MACHINERY is the title of the foreign edition, printed on thin paper and comprising all the reading and advertising matter in the domestic edition. The regular editions of MACHINERY for the last twelve months are given below:

1899.		1900.		1900.	
November	17,750	March	25,000	July	22,000
December	18,500	April	21,500	August	21,500
1900		May	21,500	September	21,750
January	20,000	June	27,500	October	24,000
February	20,500				

RECLAIMING LAND FOR FACTORY SITES.

At last it appears that part of the enormous annual refuse from New York City is to be put to practical use instead of being dumped out at sea. The owner of a tract of the salt meadows or sea marshes fronting on Newark Bay at Elizabethport, N. J., has contracted for the excavated materials from the subway now being built. The excavated materials are to be used for raising the level of his land, now practically valueless, to make it available for factory sites. This method of reclamation, while costly, is undoubtedly the only feasible means of rendering the salt meadows of New Jersey useful for building purposes.

When the value of all such reclaimed lands in the near vicinity of New York, for factory sites alone, is considered, it becomes a source of wonderment why steps have not heretofore been taken to make them available by filling in with the great quantities of excavated materials and ashes gathered from New York and dumped out at sea. Much of this matter is said not to be carried out by the rascally contractors to such a distance, but that it becomes a risk to navigation, thereby causing a large annual expense for dredging to keep channels at proper depths.

The value of factory sites near New York City is enhanced by the desire of many manufacturing firms and machine shops now located therein to escape the restrictions and expenses consequent to their present location and still enjoy the advantages of the unrivalled shipping facilities afforded. Again a factory location in close touch wih the greatest commercial city of the country is a consideration that should cause the reclaiming of a substantial portion of the swamp land tracts embraced within a ten-mile radius of City Hall.

* * *

A striking example of the extent of the advance in prices of iron and steel last year is afforded in a statement made in the annual report of the Chicago Great Western Ry. for 1899. It seems that this road has actually exchanged old rails for new at a profit. They purchased 10,000 tons of 75-pound steel rails at $19 per ton. While they were being laid and the old ones taken up, the iron market advanced to such an extent that the old rails were sold for about $10 per ton more than the new ones cost.

* * *

ROGERS LOCOMOTIVE WORKS.

On the last of August it was announced in a press report that the Rogers locomotive works, of Paterson, N. J., were to finish the orders at that time on hand and close their doors, with the expectation that work would not be resumed. This action would throw 1,500 men out of employment, and would take away from Paterson its largest single industry. Naturally, much popular interest was aroused, and the mayor of the city called a public meeting for a discussion of the matter, which was of such vital importance to the city at large, and it was hoped that arrangements could be effected for the continuance of the industry, either by purchase or otherwise.

It appears that, while the works were doing a very large business, they have been at a disadvantage in many ways. The plant is old and needs new tools and new facilities, the superintendent estimating that $250,000 would have to be expended to bring it up to date. The buildings are away from any railroad line, making it necessary to haul the locomotives through the streets by horses. While, even under these adverse conditions, it is claimed that the works are still paying, Mr. Jacob Rogers, the principal owner, does not care to invest enough money to place them on a more substantial basis. Many business men and employees of the shops have offered to invest to ensure the continuance of the plant, and we trust that it will be possible to effect some satisfactory arrangement to this end.

The Rogers Locomotive Works have been owned principally by members of the Rogers family for nearly a century. A shop was started in Paterson by John Clark, of Scotland, in 1800. In 1810 Thomas Rogers, who had been a carpenter in the employ of Mr. Clark, became a member of the firm, and in 1831 founded the Rogers Locomotive and Machine Works. Cotton, woolen and flax machinery were built at first, and continued for several years to be the chief products. In 1837 the first locomotive was delivered to the Mad River and Lake Erie Railroad. In 1864 an order for nineteen locomotives for the U. S. government was completed in three months, which was considered a phenomenal record for that time.

It is to be regretted that a firm of this size and importance should not have deducted from its profits each year a sufficient allowance to cover deterioration and other causes for the natural shrinkage in its actual value. The lesson is obvious, and no moralizing is necessary.

* * *

It is stated in a press item with regard to the Baldwin Locomotive Works that their locomotives are sold only for what they actually cost, plus a fixed percentage to cover interest, insurance, and other expenses, together with a reasonable profit. Two engines, made exactly alike, by the same men, and of the same material, may differ in cost, and the purchaser will have to pay accordingly. As a rule, locomotives of similar weight and pattern can be constructed for approximately the same amount of money, but sometimes accidents and delays occur which increase the expense. An account is opened on the books with every locomotive as soon as it is begun, and the firm have a record of the cost of each one of the thousands that have left their shop.

THE DESIGN OF TUBULAR BOILERS.—1.

PLAIN DIRECTIONS FOR THIS IMPORTANT BRANCH OF ENGINEERING DESIGN.

CHAS. L. HUBBARD

It is impossible in the brief space allotted this article, to give more than an outline of the subject presented. It seems best, therefore, to treat it from the standpoint of engineers and architects in preference to that of the boilermaker, and data relating to general proportions will be given rather than the smaller details of construction coming more properly under the head of shop practice.

Boiler Horse-power.

A boiler horse-power, as fixed by the Committee of Judges of the Centennial Exhibition, means the capacity to evaporate 30 pounds of water from a temperature of 100 degrees Fahrenheit into steam at 70 pounds pressure. This is equivalent to the evaporation of 34.5 pounds from a temperature of 212 degrees into steam at atmospheric pressure, and for purposes of comparison between different boilers, their capacities are reduced to this form, known as "equivalent evaporation from and at 212 degrees."

Computing Horse-power - Heating Boilers.

The number of heat units required to evaporate 34.5 pounds of water into steam, under the above conditions, is $34.5 \times 965.7 = 33316.6$, or, in round numbers, 30,000. If we assume the following efficiencies for different kinds of heating surface: Direct 300 heat units per square foot per hour; indirect, 500 heat units; and steam blast, 1,800 heat units, then 1 boiler H. P. will supply:

100 square feet of direct surface.
60 square feet of indirect surface.
16 square feet of steam blast surface.

The following figures, by the late George H. Babcock, give the approximate number of cubic feet space which 1 boiler H. P. will heat by direct radiation:

Brick blocks in cities	15,000 to 20,000
Brick stores in cities	10,000 to 15,000
Brick dwellings, exposed on all sides	10,000 to 15,000
Brick mills, shops and factories	7,000 to 10,000
Wooden dwellings, exposed on all sides	7,000 to 10,000
Exhibition buildings, largely glass	4,000 to 15,000

Power Boilers,

In this case the power of the boiler depends upon the amount of steam required by the engine. Prof. Thurston gives the following as the average steam consumption in pounds per hour per H. P. for the best classes of engines in common use, and in good order.

Table I.

TYPE OF ENGINE.	Gage Pressure.	RATIO OF EXPANSION.					
		2	3	4	5	7	10
Non-condensing.	30	40	39	40	40	42	45
	45	35	34	36	36	38	40
	60	30	28	27	26	30	32
	75	28	27	26	25	27	29
	90	26	25	24	23	25	27
	105	25	24	23	22	22	21
	135	24	23	22	21	20	20
Condensing.	15	30	28	28	30	35	40
	30	28	27	27	26	28	32
	45	27	26	25	24	25	27
	60	26	25	25	23	22	24
	75	26	24	24	22	21	20
	105	25	23	23	22	21	20
	135	25	23	22	21	20	19

In using this table, a margin should be allowed for running feed pumps, etc., or for any other purposes where steam is required.

Heating Surface.

There is quite a difference in opinion among authorities, regarding the methods of measuring the heating surface of tubular boilers. A safe rule is to take ½ the external area of the shell, the inside surface of all the tubes and 2/3 of the rear head minus the sectional area of the tubes.

Heating Surface per Horse-power.

A well-proportioned boiler with clean tubes, and cared for by an experienced fireman, will easily develop 1-12 of a H. P. for each square foot of heating surface; but for heating boilers, and other cases where the best of care is not always assured, it is better to allow 15 square feet per H. P. This gives a margin for an emergency, as with careful firing and good chimney draft a boiler thus proportioned may easily be made to develop a capacity from 30 to 50 per cent. above its rating.

Table II.

Diameter of Shell in inches.	Number of Tubes.	Diameter of Tubes.	Sq. feet of Heating Surface in Heads.	Sq. feet of Heating Surface in one Linear Foot of Shell and Tubes.	Horse-Power in one Linear Foot of Shell and Tubes.
30	28	2½	2.8	20.7	1.37
36	34	2½	4.0	25.0	1.67
42	34	3	5.3	30.2	2.00
48	44	3	7.2	38.4	2.56
54	54	3	9.3	46.4	3.10
	46	3½	8.8	46.3	3.10
60	72	3	11.2	59.6	4.00
	64	3½	10.5	62.4	4.16
66	90	3	13.5	74.2	4.95
	78	3½	12.6	75.2	5.10
	62	4	12.4	69.2	4.60
72	114	3	15.7	92.5	6.16
	98	3½	15.0	93.0	6.20
	72	4	15.0	79.7	5.31

Table II. will be found useful in determining the required size of boiler for a given H. P.

Grate Surface.

The size of grate required depends upon the rates of combustion and evaporation for any special case.

Rate of Combustion.

In well designed power plants the rate of combustion is seldom less than 15 pounds of coal per square foot of grate surface per hour, but for heating boilers a combustion of 8 or 10 pounds is more common, or even less, in small plants.

Rate of Evaporation.

The weight of water evaporated per pound of coal depends upon the design and care of the boiler and the kind of fuel used. Kent gives the following as average practice:

Good boiler and coal	9 to 10 pounds.
Fair boiler and coal	7 to 8.6 pounds.
Poor boiler and coal	5 to 6.9 pounds.

Having assumed the probable rate of combustion and evaporation for any given case, the required grate area can be computed from the following formula:

$$\frac{30 \times \text{H. P.}}{\text{Rate of Combustion} \times \text{Rate of Evaporation.}} = \text{Square Feet of Grate,} \quad (1)$$

Table III.

Rate of Evaporation.	SQUARE FEET OF GRATE PER HORSE-POWER. Rate of Combustion.				Pounds of Coal per H. P.
	8 lbs.	10 lbs.	12 lbs.	15 lbs.	
10	.43	.35	.28	.23	3.43
9	.48	.38	.32	.25	3.83
8.6	.50	.40	.33	.26	4.00
8	.54	.43	.36	.29	4.31
7	.62	.49	.41	.33	4.93

Table III. gives useful data for calculating the grate area for different conditions.

The ratio of grate to heating surface in tubular boilers varies from 1 to 30, to 1 to 40. For example, if we assume 15 square feet of heating surface per H. P., and the rates of combustion and evaporation as 10 and 8, respectively, we shall have a ratio of 40; while if the rates of combustion and evaporation are 8 and 7.5, the ratio falls to 30. Taking the case of a power boiler of the best class and allowing 12 square feet of heating surface per H. P. and rates of combustion and evaporation of 12 and 9, we have a ratio of 43. For the best economy with any kind of fuel, the proportion should be such that there will be at least 1 square foot of heating surface for each 3 pounds of water evaporated.

Ratio of Grate to Smoke Passages.

The areas of the smoke passages are usually proportioned to bear a certain relation to the grate surface. It is common practice to make the area over the bridge wall 1-7 that of the grate area, while the tubes may be from 1-8 to 1-9 for anthracite and from 1-6 to 1-7 for bituminous coal.

The smoke pipe and chimney should have areas of about 1-7 the grate for heating boilers, and 1-8 to 1-9 for power. These figures are for anthracite coal and the area should be somewhat increased for bituminous. All of the above proportions are for average draft, with a combustion of 10 or 12 pounds of coal per square foot of grate.

If, however, the draft should be increased, and the grate area correspondingly reduced, the sizes of the smoke passages should not be changed, as the products of combustion remain the same as before, and it is not well to increase the velocities in the passages over those given by the above proportions.

Tubes.

The sizes of tubes most commonly used are those having outside diameters of 2, 2½, 3, 3½ and 4 inches. A common rule for determining the diameter of tubes to be used for any given length of boiler, is to allow 1 inch in diameter for each 5 feet in length for anthracite coal and 4 feet for bituminous. Table IV. gives the usual proportions of boiler tubes.

Table IV.

External Diameter	Internal Diameter	External Circumference.	Internal Circumference.	External Area	Internal Area.	Weight per Foot.
2	1.8	6.28	5.66	3.14	2.55	1.91
2½	2.28	7.85	7.17	4.90	4.09	2.75
3	2.78	9.42	8.74	7.06	6.08	3.33
3½	3.26	11.00	10.24	9.62	8.35	4.28
4	3.74	12.56	11.75	12.56	10.99	5.47

Tube Sheet.

The number and arrangement of the tubes for any given diameter of boiler is a matter of much importance. The tubes should not be crowded too closely together, as increasing the number beyond a certain limit decreases their efficiency as heating surface Table V. gives what experience has found to be an effective number of tubes for boilers of different diameters. These,

Table V.

Diameter of Shell.	Number of Tubes.	Diameter of Tubes.	Diameter of Shell.	Number of Tubes.	Diameter of Tubes.
30″	28	2½″	60″	64	3½″
36″	34	2½″	66″	90	3″
42″	34	3″	66″	78	3½″
48″	44	3″	66″	62	4″
54″	54	3″	72″	114	3″
54″	46	3½″	72″	98	3½″
60″	72	3″	72″	72	4″

however, may be somewhat increased in special cases, if so desired. There should be a clear space of 1 inch between the tubes both vertically and horizontally, with a vertical space of 2 inches at the center. Tubes should not be placed nearer than 3 inches to the boiler shell owing to the grooving effect of unequal expansion.

Steam Space.

In heating boilers, it is customary to make the steam space about 1-3 the contents of the boiler, after deducting the space occupied by the tubes. For power boilers it is more usual to compute it from some rule depending upon the amount of steam used by the engine. A common method is to make it equal to the volume of steam consumed in 20 seconds, for engines of moderate speed.

Water Line.

The normal water line should be from 3½ to 6 inches above the upper row of tubes; 5 inches is usual for boilers 54 and 60 inches in diameter.

Effect of Riveted Joints.

The strength of a riveted joint is always less than that of the solid plate. The ratio of the former to the latter is called the "efficiency" of the joint. The types of joints most commonly used are the "single-riveted lap joint," the "double-riveted lap joint," the "double-riveted butt joint" and the "triple-riveted butt joint." In the best class of work it is usual to drill the rivet holes with the plates in position, so that they may come fair for riveting.

It was formerly the custom to punch the holes, but experiment has shown that where this is done, the metal around the holes is weakened. A soft and ductile metal appears to be less affected than a hard one, and soft steel plates are injured less than wrought iron. The holes are often punched a smaller size than required, the plates are then rolled to form, and the holes drilled out to the proper size. This method seems to give as good results as when all the metal is removed by the drill.

Pitch of Rivets.

The distance between the rivets is determined partly by calculation and partly by practical considerations. They should be near enough together to hold the plates up rigidly, so that a tight point may be secured without excessive calking. Examples will be given later showing usual proportions for different kinds of joints. In these examples we will assume steel plates and rivets, with the following maximum resistances:

Tension .... 55,000 pounds per square inch.
Shearing .... 43,000 pounds per square inch.
Compression .... 95,000 pounds per square inch.

Single-riveted Lap Joint.

This joint may fail in three ways: 1st, by shearing the rivets; 2d, by tearing the plate between the rivets; 3d, by crushing rivets or plate.

There are various methods for proportioning the parts of a joint by equating the different resistances to each other, but I have found it fully as satisfactory to first assume such dimensions as good practice has seemed to indicate, and compute the efficiency. After this is done, it is easy to see how a change either in pitch or diameter of rivets will increase the strength of the joint, and then by one or two slight changes the maximum efficiency is soon found.

Let us assume for a single-riveted joint:

Thickness of plate.................. ½ inch.
Diameter of rivets.................. 1 inch.
Pitch of rivets .... 2¼ inches.

Then, taking a section of the joint equal in length to the pitch of the rivets (see Fig. 1), we have for the 1st case a resistance of $.7854 \times 43{,}000 = 33{,}772$ pounds (area of rivet × shearing

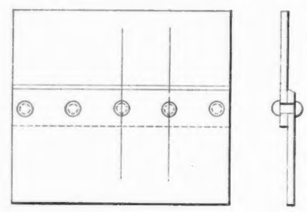
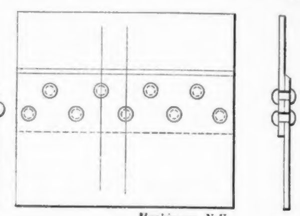


Fig. 1.



Machinery, N.Y.

Fig. 2.

strength.) For the 2d case, $(2\frac{1}{4} - 1) \times \frac{1}{2} \times 55{,}000 = 34{,}375$ pounds (area of plate between rivets × tensile strength). For the 3d case, $1 \times \frac{1}{2} \times 95{,}000 = 47{,}500$ pounds (area of rivet or plate subjected to compression × resistance to crushing).

Table VI.

Thickness of Plate...........	¼	5/16	⅜	7/16	½
Diameter of Rivets..........	⅝	11/16	13/16	15/16	1
Pitch of Rivets	1⅝	1¾	2	2¼	2¼
Efficiency of Joint...........	57%	54%	55%	56%	55%

Table VII.

Thickness of Plate...........	¼	5/16	⅜	7/16	½
Diameter of Rivets..........	9/16	11/16	13/16	15/16	1
Pitch of Rivets	2	2½	3	3½	3½
Efficiency	70%	72%	73%	74%	72%

Table VIII.

Thickness of Plate...........	¼	5/16	⅜	7/16	½
Diameter of Rivets	9/16	⅝	¾	⅞	15/16
Pitch of Inner Rivets........	1⅜	1⅝	2	2⅜	2⅝
Pitch of Outer Rivets........	2¾	3¼	4	4¾	5¼
Efficiency of Joints	80%	80%	81%	81%	82%

Table IX.

Thickness of Plate..........	¼	5/16	⅜	7/16	½
Diameter of Rivets..........	9/16	⅝	¾	⅞	15/16
Pitch of Inner Rivets.......	2½	2¾	3⅛	3½	3¾
Pitch of Outer Rivets	5	5½	6¼	7	7½
Efficiency of Joint...........	88%	88%	90%	90%	88%

A strip of solid plate of equal length is found to have a resistance of $2\frac{1}{4} \times \frac{1}{2} \times 55{,}000 = 61{,}875$ pounds. If the weakest part of the joint, which is case 1, be divided by the strength of the solid plate. we shall have the efficiency of the joint, which in this case is $\frac{33772}{61875} = 54.5$ %. By increasing the diameter of the rivets, it would increase the resistance to shearing, but would correspondingly reduce the area of the plate between the rivets, so that the strength of the joint would remain about the same or be even less, if the rivets were increased too much.

Lap.

The distance from the center of the rivet holes to the edge of the plate is called the lap, and is commonly made 1.5 times the diameter of the rivet for lap joints. Table VI. computed as above gives the following proportions for different thicknesses of plate.

Double-riveted Lap Joint.

This joint may fail in three ways, as follows: 1st, by shearing two rivets; 2d, by tearing the plate between two rivets; 3d, by

crushing in front of two rivets. The method of calculation is the same as before. The distance between the two rows of rivets may be made equal to 2-3 of the pitch. Table VII. gives proportions for double-riveted lap joints. In Fig. 2 the pitch lines indicate one-half the pitch instead of the whole pitch.

Double-riveted Butt Joint.

This joint may fail in five ways: 1st, tearing at outer row of rivets; 2d, shearing 2 rivets; 3d, tearing at the inner row of rivets and shearing one of the outer row of rivets; 4th, crushing in front of 3 rivets; 5th, crushing in front of 2 rivets, and shearing 1 rivet.

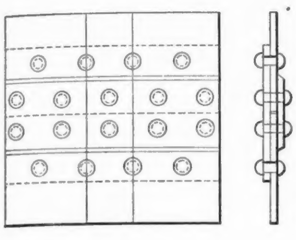


Fig. 3.

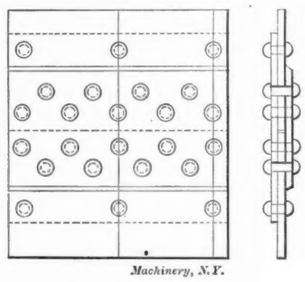


Fig. 4.

For the butt joints, both double and triple riveted, the lap should be slightly increased over that given by the rule previously stated. If 1-16 of an inch is added to the diameters of the rivets given in Tables VIII. and IX., and the lap computed from these new diameters, it will be found sufficient. The cover plates are made the same thickness as the shell, in the above table.

Triple-riveted Butt Joint.

This joint may fail in five ways: 1st, tearing at outer row of rivets; 2d, shearing 4 rivets in double shear and 1 in single shear; 3d, tearing at middle row of rivets; 4th, crushing in front of 4 rivets and shearing 1 rivet; 5th, crushing in front of 5 rivets. The thickness of cover plates is taken as 1-16th of an inch less than the shell plate, except for the ¼th-inch plate, in which case it is made the same.

The following table will be found useful in designing riveted joints:

Table X.

Diameter of Rivet or Thickness of Plate.	Decimal Equivalent.	Sectional Area of Rivet.	Diameter of Rivet or Thickness of Plate.	Decimal Equivalent.	Sectional Area of Rivet.
¼	.2500	.0490	11/16	.6875	.3712
5/16	.3125	.0767	¾	.7500	.4417
⅜	.3750	.1104	13/16	.8125	.5184
7/16	.4375	.1503	⅞	.8750	.6013
½	.5000	.1963	15/16	.9375	.6902
9/16	.5625	.2485	1	1.0000	.7854
⅝	.6250	.3067			

* * *

MACHINE TOOLS, THEIR CONSTRUCTION AND MANIPULATION.—12.

PLANER AND SHAPER TOOLS AND ATTACHMENTS.

W. H. VanDervoort.

Many of the cutting tools used on the planer and shaper are the same as those used on the lathe, as, for example, the side-cutting, diamond-point and cutting-off tools. There are, how-

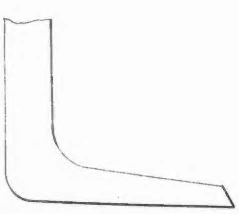


Fig. 104.

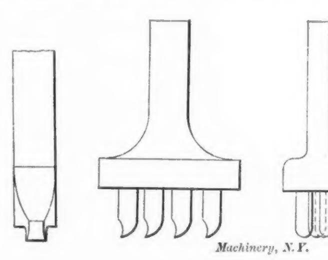


Fig. 106.

ever, several forms specially adapted to planing operations. The extended nose tool shown in Fig. 104 is used for cutting keyways or for any class of internal work. This tool, unless short and heavy, springs badly. It should be held as high in the tool holder as permissible, thus reducing the spring to the least amount possible. The shape of the cutting edge is suited to the character of the work and should be given as small an amount of bottom clearance as will enable it to take hold of the cut, otherwise it will dig into the work badly. The Armstrong planer tool shown in Fig. 105 takes the place of several forms of ordinary planer tools, as top roughing, right and left side roughing and right and left under-cut, all as shown in the figure. It may also be used to hold cutting-off blades or formed cutters of any class. A tool of this kind for the planer possesses the

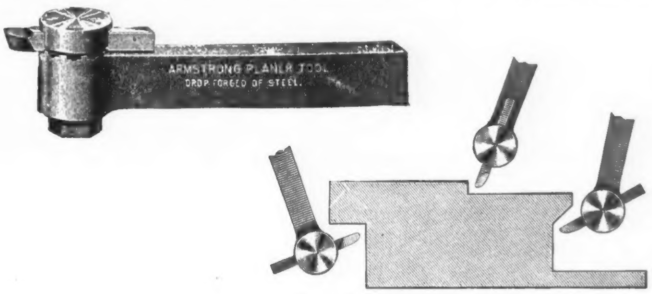


Fig. 105.

many advantages of similar tools for the lathe in which a small cutting tool of self-hardening steel, ground rather than forged to shape, is used.

The gang tool shown in Fig. 106 is often used on the planer where the surface to be machined is large and comparatively regular in outline. It consists, as shown, of several tools set one back of another in a suitable head held in the tool clamps in the usual manner. The cutting points are so adjusted that each takes the regular cut desired so that a regular feed of, say, 1-16 in. on each cutter would, on a gang cutter tool, enable the head to be fed over the surface one fourth of an inch at each depended upon to produce satisfactory work when good ma-

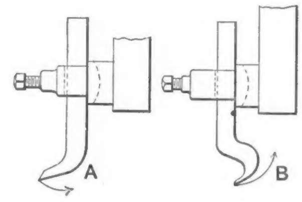


Fig. 107.

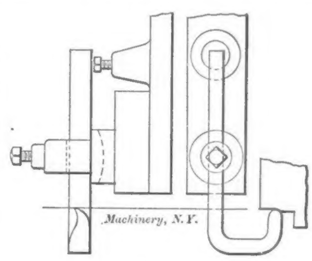


Fig. 108.

chined surfaces are required, as the spring of the roughing cutter due to the inequalities of the work surface is communicated to the finishing cutter, and this must, as a result produce a finished surface having much of the irregularity of the original rough one.

Planer and shaper tools should almost without exception be ground with very little bottom clearance. The rake should be suited to the hardness of the metal being machined. It is advisable, when possible, to have the cutting edge well back under the head so that the spring of the tool and head will not cause

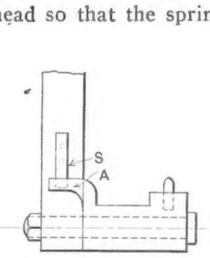


Fig. 109.

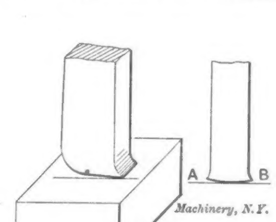


Fig. 110.

the cutting edge to dip into the work surface; it also tends to prevent chattering. This point is illustrated in Fig. 107, where at A is shown a tool whose cutting edge is well ahead, and at B one with the cutting edge well back. The dotted lines show stroke of the work. Tools of this character with special formed cutting edges are much used on special work. A tool of this class carrying a roughing and a finishing cutter must not be the path the cutting edge tends to follow in each case, due to the spring of the tool itself. The spring of the head tends in each case to let the point into the work, but not so badly in the case shown at B as at A. On all top and side cuts the tool swings out and away from the work surface on the return stroke. For under cuts, however, except those of comparatively

slight angle from the vertical, where the head can be angled to meet the condition, the tool must be held from swinging out on the return stroke, as it would in that case cause trouble, lifting the work or breaking it, the tool, or the head. For under cuts the tool should have a long shank extending well above the clamp and blocked out at the top as shown in Fig. 108. As the tool drags back heavily in such cases, the wear on it is excessive. A side head, due to its position, is well adapted to under-cut work. Where much under-cut work is to be done and a side head is not available or, owing to the position of the work sur-

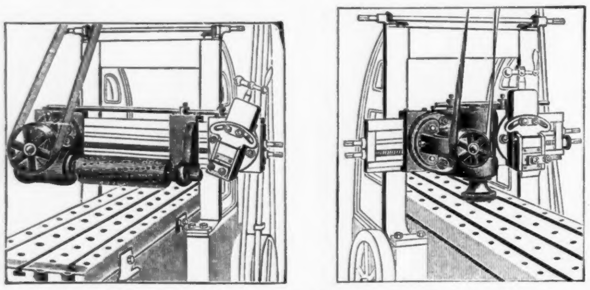


Fig. 111. Attachments; the Adams Co., Dubuque, Ia.

face, not adapted, a relieving tool similar to the one shown in Fig. 109 can be made at a small expense. In this tool a stud projecting from the side of the shank carries a small tool holding the collar, which can rotate on the stud until the stop A strikes the shank. A light spring S bears against the stop, allowing it and the tool to swing back from the work on the return stroke and bringing it back again for the beginning of the forward stroke. For finishing cuts at coarse feeds the broad nose tool shown in Fig. 110 is used. The corners are slightly rounded, as shown at A, B, and the tool given only a slight amount of clearance, as shown.

The planer and shaper, when equipped with suitable attachments, are capable of a very wide range of what might be termed special tooling operations. An emery-grnding head is secured to the cross rail with suitable belted connections to drive its wheel and the planer table at the proper speeds, and the planer is converted into a very creditable plane-grinding machine. This transformation, however, is not to be advocated, as the

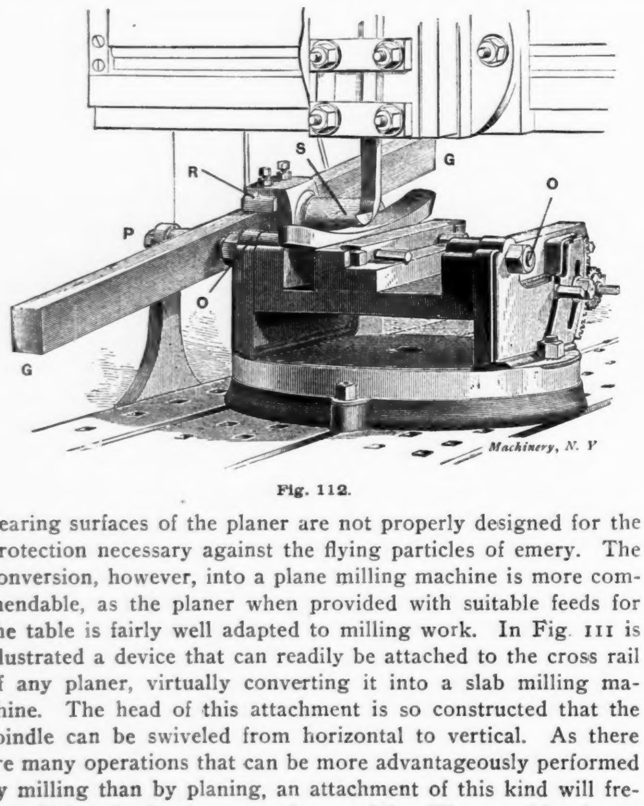


Fig. 112.

bearing surfaces of the planer are not properly designed for the protection necessary against the flying particles of emery. The conversion, however, into a plane milling machine is more commendable, as the planer when provided with suitable feeds for the table is fairly well adapted to milling work. In Fig. 111 is illustrated a device that can readily be attached to the cross rail of any planer, virtually converting it into a slab milling machine. The head of this attachment is so constructed that the spindle can be swiveled from horizontal to vertical. As there are many operations that can be more advantageously performed by milling than by planing, an attachment of this kind will frequently be of value in cases where a slab milling machine is not available. In Fig. 112 is shown an attachment for planing concave or convex surfaces. It consists principally of a vise pivoted in suitable housings at the points O O. The arm S is a part of the vise and carries within it a stud terminating in the guide R. The bar G G is secured at any desired angle with the table to the post P, which is fastened to the side of the planer bed. If G G is parallel to the work table the vise will have no motion relative to its housing. If the bar is set as shown in the figure the farther end of the vise elevates as the table advances to the cut and a concave surface results. By inclining the bar in the opposite direction, however, the end drops as the table advances to the cut and a convex surface results. The arc of the circle planed depends on the amount of the angle between G G and the table; the greater the angle, the smaller the radius of the surface planed. With the bar G G removed, the vise becomes an ordinary planer vise, possessing the additional advantage of being adjustable to quite an angle with the work table, a point of value in the planing of wedges.

Planer vises are very necessary accessories to both the planer and shaper, as a considerable amount of planer, and more especially shaper work must be held in the vise. In Fig. 113 are shown two forms of planer vises. The vise shown at A has a plain base, to be clamped in any desired position on the planer table. The adjustment of the movable jaw is clearly shown in

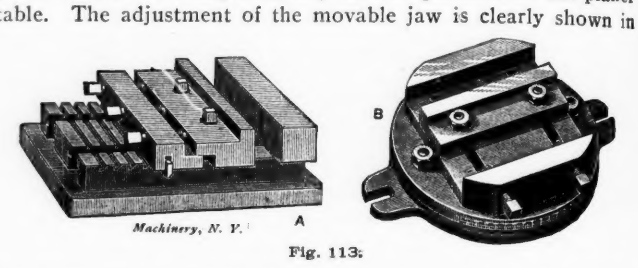


Fig. 113.

the figure. The vise shown at B is provided with a circular base usually fitted with two tongues to fit the wards on T-slots in the planer table and thus insure its being put on at the same angular position with the line of the table's motion. The circular bottom of the vise is pivoted at the center of the base and provided with a graduated rim, thus making it possible to set the jaws at any desired angle with the table's length. In this vise blocking is used between the clamping screws and the movable jaw. It is quite necessary in any planer vise to have the movable jaw so secured that it can be clamped down closely to its seat, as otherwise the clamping of the work between the jaws will cause it to lift. The shaper vise is considered a regular shaper attachment, and is always furnished with the machine. The sliding jaw is always operated by a screw and gibbed to the body of the vise.

The attachment shown in Fig. 114 is a special tool for the planing of circular surfaces, as, for example, locomotive driving boxes. Its range is comparatively small. The long shank is held in the regular tool clamps. The head of the attachment is pivoted at its center in the end of the arm and operated by a shaft carried in a recess in the back of the arm. A worm and worm gear at the upper end of the bar provides a suitable feed drive for rotating the tool. When a considerable amount of work is to be done with the attachment a suitable automatic feed can readily be applied to the worm.

The milling machine has taken most of the center work away from the planer. A pair of planer centers, however, an example

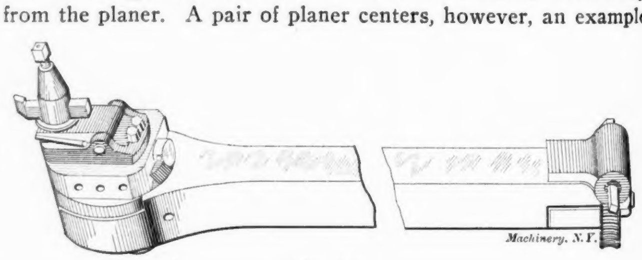


Fig. 114.

of which is shown in Fig. 115, is frequently of great value. They are usually tongued to fit the wards in the table, and the head spindle is so indexed that the circle can be divided into a large series of equal parts.

In Fig. 98 of the preceding article is illustrated a number of shaper attachments. The one shown on the machine is for planing spirals. The spindle of the head is rotated back and forward with the strokes of the ram through a suitable geared mechanism operated by the up-and-down motion of the block over which the inclined guide (which is actuated by the stroke of the ram) slides. The work to be operated upon is held between centers, and as the upper section of the knee can be in-

clined, spirals can be shaped upon tapered work. The shaper vise is shown at the rear of the cut. Two small centers attached to the jaws, as shown, are frequently found very convenient. The vise wedges shown on the extended base of the shaper are pivoted at the center and are used against one of the jaws of the vise in holding tapered work.

In the front and on the left of the cut is shown a convex shaping attachment. This may be secured to the front of the cross rail in the place of the knee, and the feed attached to the geared feed mechanism shown, which gives the circular table and such work as may be clamped on it a rotating feed motion. This device can also be secured to the knee in a horizontal position for operating upon special work requiring the machining of radial surfaces.

The circular attachment shown in the center of the foreground is provided with an arbor carrying two cones. Work having any bore within the limits of the cones can be held on the attachment, an automatic feed giving the work feed rotation. The index centers shown on the right are in principle similar to those shown in Fig. 115. They are, however, self-contained, both head and tail stock being secured on a suitable base casting, which in turn may be secured to the knee of the shaper.

Spiral planing attachments similar to the one shown in Fig. 98 are frequently applied to planers for the grooving of spiral rods and work of that class. Another attachment for the cutting of spirals on the planer consists of a rack secured to the side of the planer bed at about the height of the surface of the work table. A pinion carried on a shaft running in bearings secured to the surface of the table and at right angles to its length gears with the rack. This cross shaft through a pair of bevel gears transmits its motion to a spindle parallel with the table's length and to which the work to be spirally planed is attached. The motion of the table causes the shaft spindle and work to rotate at a rate determined by the velocity ratio of the gears.

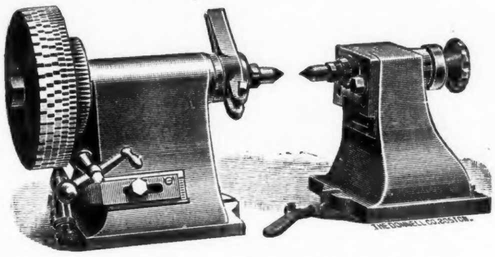


Fig. 115. Planer Centers; Fay & Scott, Dexter, Maine.

A shaper is sometimes used for key seating. There is a vertical supporting knee attached to the table for holding the work, and a special head attached to the ram in place of the ordinary tool block. This head holds a cutter bar, which is in the form of a broach, and will cut the keyway at one stroke of the ram.

* * *

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP.
Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

HOBBING DIES.

"De Soulo," Chicago, Ill., sends a kink, which, while it takes but little room in our columns to describe it, may be worth more to many of our readers than many items that require much more space. He writes: "Our toolmakers who, in the course of a year make hundreds of small-thread dies for straight-thread work, never think of making a die without using the following point: When the blank is all tapped and ready to receive the lead they make it a point always to put the lead on the opposite side from that which the tap entered, claiming that the die will cut freer and without binding and will leave the threads sharper and more perfect in every way than if the lead were placed on the side the tap entered. They claim that the tap leaves a very slight taper, and that this eases up the cutting quality of the die and prevents the dragging."

CHIP BOX.

A. A. L. sends a sketch of a chip box (Fig. 1) to be placed under the bed of a lathe. The special feature is a small box B which can be so placed as to catch brass turnings. The main box is an ordinary chip box of the full length and width of the lathe bed. There are cleats, A, A, nailed to the inside of the side pieces of the box to support the brass box B, which is shown closed at the right in the upper view and appears opened and in a position to catch the brass chips in the lower view. The cover of box B has about half the depth of the box itself and when the latter is closed, and moved to the extreme right, its top comes even with the top of the main box. The cleats are so placed, however, that when the box B is opened and moved to the left, the cover and the body of the box will be supported with their tops even with the top of the main box, as in the second sketch, and will thus catch the turnings from all except the longest work. Upon closing the cover the chips which it contains fall into the box, where they are retained.

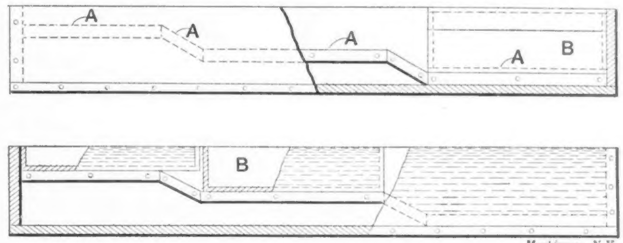


Fig. 1.

PLANING ROUND WORK.

"Student" sends a sketch of jig for planing circles on work such as links, straps, etc. A is a spindle turned in its bearings by a worm and worm gear B, operated by link c through feed-rod D and notched wheel H. The feed is readily understood by any one familiar with shaper feeds. E is adjustable to enable the table to be raised or lowered to suit the work, while the number of notches fed on wheel H is determined by moving G up or down in the groove. It is easily seen that the work is revolved by the spindle A and then a true circle is planed.

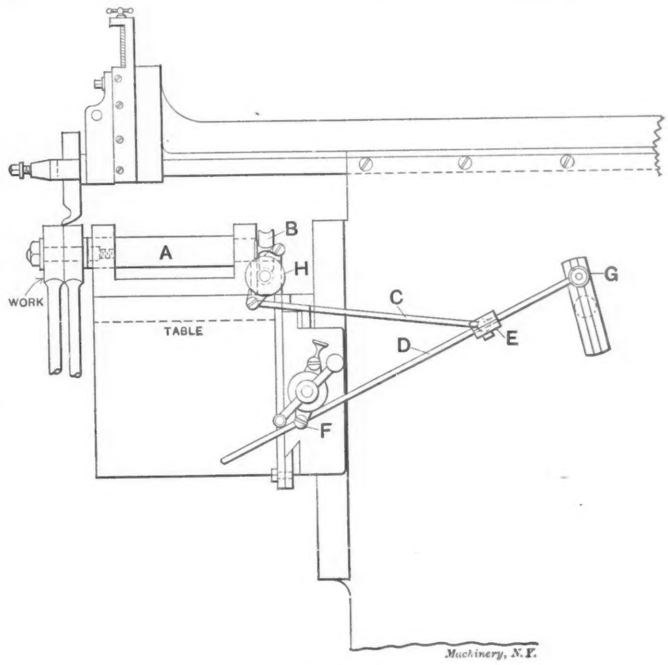


Fig. 2.

FLY CUTTER.

Mr. Fred Harrison, Philadelphia, Pa., writes that he has made and used a fly tool, of which a sketch is shown in Fig. 3, that is useful for cutting brass, bronze, or any soft metal. The dimensions on the sketch show a size suitable for a Becker No. 2 vertical milling machine, or any other similar milling machine of corresponding size. Mr. Harrison states that he was formerly kept busy grinding cutters of the end-mill style and designed this tool to take their place on a great variety of work. He finds that it reduces the time two-thirds on bronze and brass boxes. All that is required in grinding is to loosen the set-screw, take out the blade and grind it on its faces on the grindstone or

emery wheel, replace the blade, and "away we go." The cutters can be made to cover different widths of work. They have been used from 2 to 4 inches long and it is expected to make them in

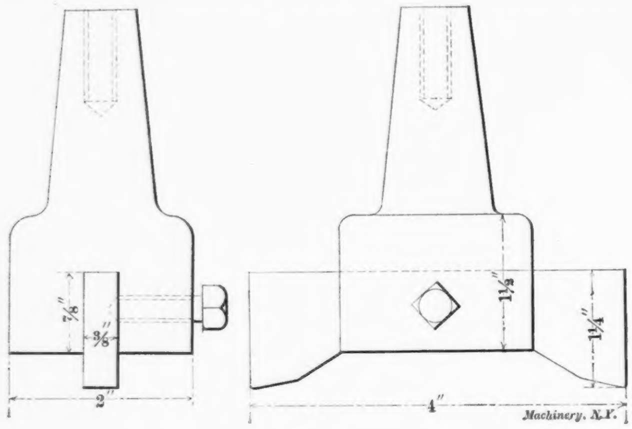


Fig. 3.

larger sizes. For average work the cutter shown will run at a speed of about 300 revolutions per minute.

CUTTING OFF SMALL PIECES.

R. H. Hampson, Anniston, Ala., sends a sketch of a handy jig for cutting off small work. He writes: I had three hundred pins to make, like the one in the sketch, and as I did not have a hollow-spindle lathe I made the studs double and cut them apart at A. A machinist who has had to cut off little work like this between the lathe centers knows what a job it is. I first

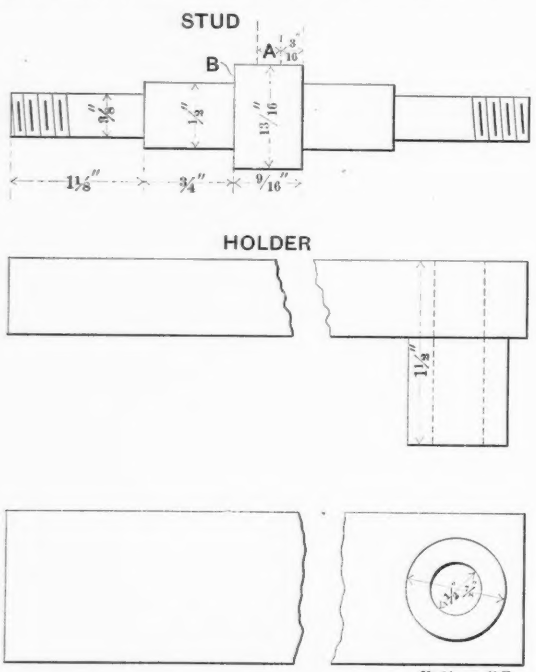


Fig. 4

turned the pins and threaded them. I made a slitting cutter and fastened it on a mandrel, which was placed between the centers, and was driven by the lathe spindle. I then made a holder, as in the lower part of the sketch, which fitted in the tool post of the lathe. One end of the pin fitted in the holder up to the shoulder B. A nut was used on the thread to hold the pin fast in the holder. The work was then moved to the cutter as if to take a cut with the tool.

METHOD OF REPAIRING BROKEN DRILL SHANKS.

E. J. B., Dubuque, Ia., says: I send you herewith two "kinks" which may be useful or interesting to some of the mechanical fraternity. In the shop where I am employed as tool-room man, we have had a great deal of trouble by the breaking of the tangs of twist drills of various sizes which are used on cast-steel castings. We tried the old way of turning up the shank and milling a new tang, but found it was soon broken off again and then we were in the "soup," so to speak. I finally adopted the following means to overcome the difficulty, and have found that a drill once fixed in this way will never give out at the shank again.

On drills with a No. 1 shank we square up the end that is broken off, and get an old drill that is worn out and which has a No. 2 shank. We cut off the stump of the drill and insert it in a nice true drill socket which has been fitted to the lathe spindle. The drill shank is bored and reamed out to fit the No. 1 shank with a Morse standard taper reamer, leaving it enough smaller to shrink on to the broken shank. When the job is done in this way the trouble is over. It will be necessary to drill a 1-16" hole in the shank to be put on, to allow the air to escape from the bore when slipping on. If a No. 2 shank is broken, cut off an old No. 3 shank and proceed as before.

BROACHING DEVICE.

"Inspector," Chicago, Ill., writes: While passing through a shop recently I observed a little "kink" they used in broaching a keyway in iron collars, perhaps 3½ in. diameter and ½ in. thick.

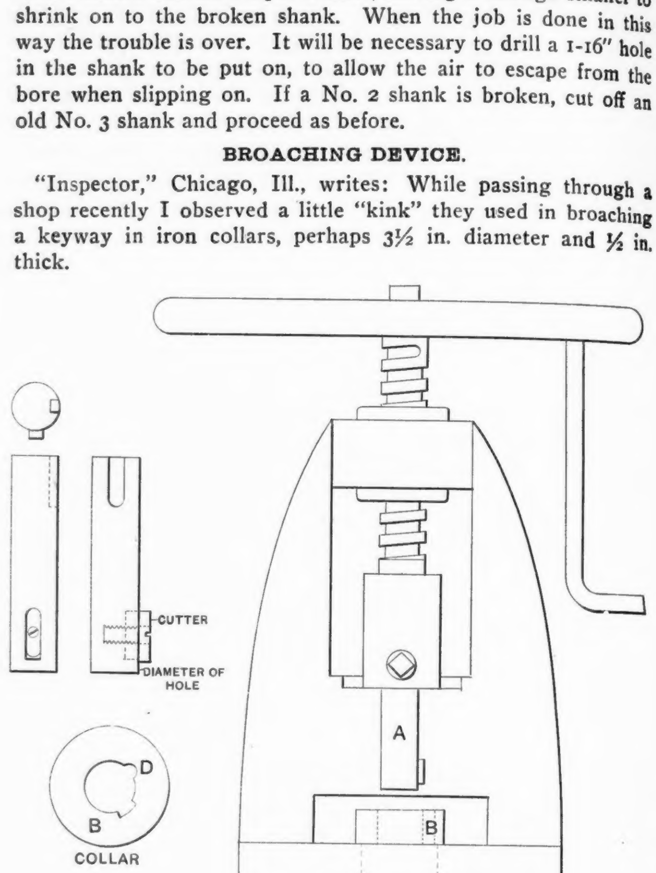


Fig. 5.

In the slide of a large screw press was placed a broach shown at A, the broaching cutter being firmly recessed into the shank, and the size of the shank being a smooth fit for the hole in the collar. The broach was set in the shank perhaps ¾ in. from the lower end, this space serving as a guide. Before broaching the collars a chip was chiseled out with a ½-inch round chisel as at D, so as not to give the broach too much to do. The space broached out was about ½ in. wide and perhaps ¼ in. deep, and was clean cut and accurate.

IMPROVED ANGLE PLATE.

Harry Ash, Chicago, Ill., says that Figs. 7 and 8 are sketches of an angle plate which he finds from experience to be far superior to the fancy designs such as Fig. 6, which are so common, inasmuch as the steps are very convenient for supporting

Fig. 6.

Fig. 7

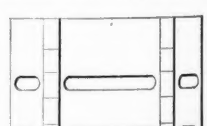


Fig. 8.

clamps. The slotted holes in the face of same are an additional convenience for using various clamps. Two or three various sizes of angle plates, such as shown in Figs. 7 and 8, will be found quite valuable in the shop.

* * *

The amount of coal mined in Great Britain in 1899 was 220,000,000 tons, or twenty-two times as much as was mined in 1800, which date marks the first application of the steam elevator in coal mining.

LETTERS UPON PRACTICAL SUBJECTS.

WELDING ENGINE FOUNDATION BOLT.

Editor MACHINERY:

The article by "Central West" in the August issue caused me to think that a description of a job which I have just done might be of use to some fellow member of the craft, or would, at least, be interesting.

A 1¾ inch foundation bolt broke off at the bottom of the thread in the final screwing down after the engine was set and grouted. As the bolt was bent on account of a column foundation it was impossible to screw it out. As it would also be next to an impossibility to dig out or cut out nine feet of concrete foundation, I was very near "up a tree." I managed, however, to make a first-class job of it in the following manner: I cut

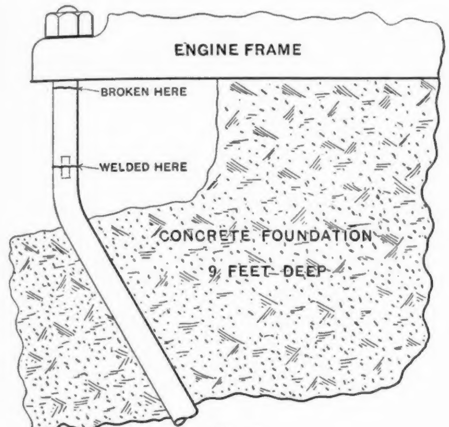


Fig. 1.

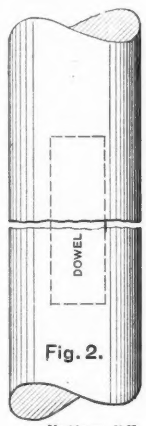


Fig. 2.

Machinery, N.Y.

out the concrete about fourteen inches under the engine and then sawed off the broken bolt, leaving about three inches of a stub. The end of the stub was drilled for a ⅝-inch dowel pin and then a bolt end was drilled to correspond, for a dowel to fit the stub. After placing it in position I made a fire, using good Cumberland coal, and by getting a blast by means of a hose connected to an air-compressor receiver, and using a sand flux to prevent wasting, I got a nice soft heat. I allowed about one inch to stave up, and by tapping it down with a sledge I made a splendid butt weld that was perfectly satisfactory. After filling in the hole with concrete and sawing off the bolt on top of the nut for finish, the job was complete,

TEXAS COW PUNCHER,

* * *

FRAMED INSTRUCTION SHEETS.

Editor MACHINERY:

It strikes me that it would be a good plan for the manufacturers of our modern machines to send with their machines a small framed instruction sheet, showing what the improvements on their machines are and how to use them, and what character of work to use them on, the instructions to be given by illustrations or otherwise, plain, but not too long.

If such instruction sheets were given and were placed in the shop in close proximity to the man using the machine, where they could be referred to readily, they would be of great help to a man going on the machine for the first time. Perhaps you will say they can get all this out of the catalogues, but how many men ever see the catalogues of the tools they work on. Many of our latest improved tools do not do the work they were expected to and fall into disrepute simply because they are not thoroughly understood in the shops where used.

I will just give one illustration, although there are many more. In one of the shops where I was employed they had a couple of Hendey-Norton lathes and had been using them for quite a while. A new man was employed to run one of them who had been running the same make lathe for two years in another shop. He said he did not think they were much of an improvement over the old style lathe, as the only thing new was the change gears. There was a lot of screw cutting being done on those lathes, and about the first thing he did was to put on a backing belt (we always used two go-ahead belts for this work) and when cutting screws he used the backing belt to reverse, and when cutting a long screw, instead of using the automatic stop, he would stop his lathe and measure back each time. The result was that he went behind in his work, and to him the Hendey-Norton lathe was not better than an old-style lathe, nor never would have been unless he got into a shop where they knew what the attachments were for.

In this shop the foreman did not know any more about the attachments than the new man, and was too busy to find out. He looked at the amount of work the man turned out, and if not satisfactory he either had to blame it to the lathe or to the man.

B. L.

* * *

ANTI-FRICTION DEVICE FOR PLANER PLATENS.

Editor MACHINERY:

I was recently somewhat amused and perplexed by an idea which was called to my attention, with the request for an opinion of its feasibility. Not pretending to be a mechanical expert, I was duly impressed by the honor conferred, but, as stated, was embarrassed in formulating an opinion of the worth of the invention. With the permission of the designer and the editor, I will call the attention of the readers to the device.

It is simply a scheme for relieving a planer platen from the frictional resistance due to bearing on the V-ways when on the return stroke. As is pretty well known, the power consumed by a planer is considerably greater on the return stroke than on the cutting stroke because in either case the frictional resistance occasioned by the weight of the platen and work on the ways is usually greater than the resistance due to the cutting action of the tool. Since the return stroke is made at a higher rate of speed than the cutting stroke, it follows that the power re-

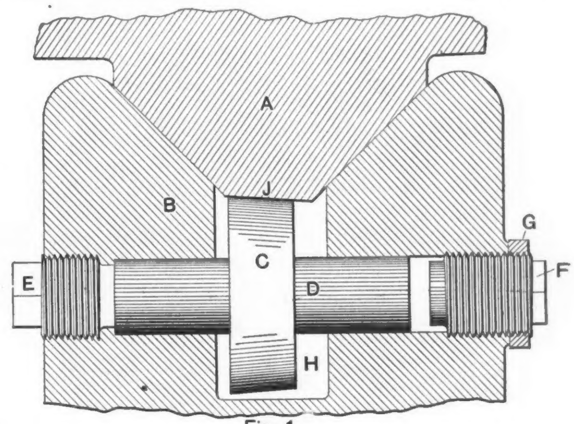
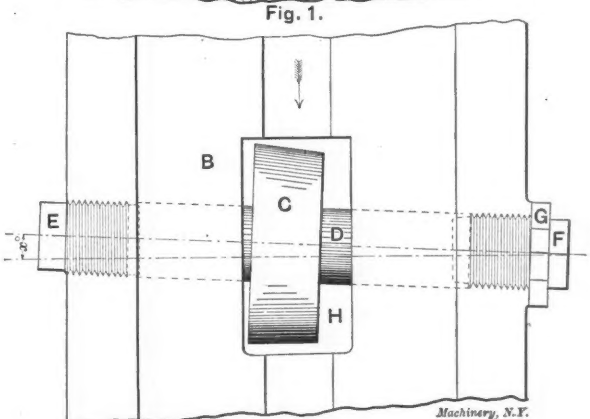


Fig. 1.



Machinery, N.Y.

Fig. 2.

quired is proportionally increased. The result is very perceptible when using large planers driven by electric motors. In order to make a motor work successfully it must have capacity nearly, if not quite, equal to the greatest power requirement of the tool, therefore necessitating the use of a motor that cannot give a high efficiency for the average work.

Having thus stated the inventor's reason for his scheme, I will briefly describe it with the aid of the accompanying cuts. The idea is, of course, to carry the weight of the platen on the return stroke, by a number of rollers, as clearly indicated in Fig. 1. Each roller is conical in shape, and the under side of

the platen V is inclined to a corresponding degree, as shown at J. The shaft D, on which the roller turns, is limited in its endwise travel by the threaded plugs E and F. In Fig. 2 the plan view of one roller is shown, by which it will be seen that the axis of the roller is set so that it makes the angle x with the right angle line crossing the planer ways. By this expedient it is confidently expected that when the platen starts on the return stroke the conical roller C, which is continually forced against the under side of the V by a spring-thrust arrangement contained in the plug E, will run under the platen by reason of its angular position and lift the platen sufficiently to break the intimate metallic contact and practically carry the weight on the revolving shaft D. The amount of lift desirable is thought to be about one-hundredth of an inch, which would require a very limited side movement of the roller, even with a cone of long taper. The plug F has a lock-nut so that the side movement can be limited to any desired amount within limits.

It is argued that the wear on the ways will be reduced one-half or more, since a better distribution of oil will be effected, and that "cutting" will be practically eliminated. The pockets, one of which is shown at H, would act as reservoirs, and the rollers would, in a measure, act as oiling devices besides carrying the weight of the platen on the return stroke.

What puzzles me is whether the device would really be operative and what the effect on the planer mechanism would be with the platen and work running back so freely. What should the angle x be and what would be the proper angle for the conical roller C? "HOOSIER."

Cincinnati, O.

* * *

SIZE GAGES FOR BICYCLES.

Editor MACHINERY:

I was employed some years ago in a gage room of a bicycle shop, making size gages. Three of each size were made at one time, one for the inspector, one for the operator and one for the foreman of the gage room to be kept for future reference. In the operating room a gage did not last more than three weeks before the size was altered to such an extent that the work was no longer interchangeable. It required much labor to make new gages and keep the old ones in repair and as there were no fixtures for doing this, the foreman asked me to devise some means whereby I could accomplish good results and not expend much money on tools.

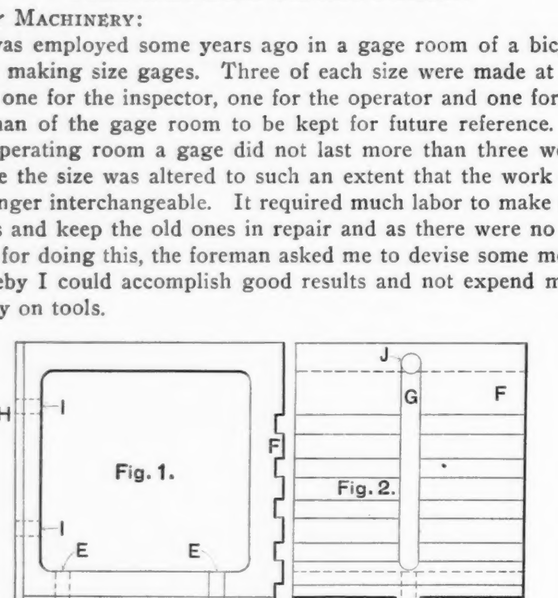


Fig. 3.

We had a vertical milling machine that was seldom used and I decided this would be very useful for milling these gages. The gages were all of the pattern shown in Fig. 3, but of various lengths. The sides A C and the end B, Fig. 3, were to be milled The faces C were milled .010 smaller than the finish size, the remainder being left for grinding after the gages were hardened For this operation I constructed the hollow knee shown in Figs. 1 and 2, the lip on the bottom fitting the slot in the table of the milling machine and clamping with two bolts through holes E E, to bring the face F of the knee parallel with the cutter. This face contained five grooves for the accommodation of the various lengths of gages. A slot G ½" wide and nearly the entire length was milled in the center of face F, Fig. 2. The gages were made so that the ends projected on each side or were wider than the handle, as shown in Fig. 3 at A A.

Having a gage to finish, the end was placed in the slot nearest in length and then clamped into position by a bolt passing through slot G, and was held by a clamp, the slot allowing the adjustment for any length of gage. At the top a hole was drilled and tapped, as shown at J in Fig. 2, an ordinary hexagon cap screw being used. It was always necessary to clamp the top of the gage in the same position. The bottom end of the gage rested in the slot and this being parallel with the table and at right angles with the cutter, the ends were always square. Each end of the gage was milled successively and the knee was then clamped on a universal milling machine with face F up and the spot D, Fig. 3, milled to allow for marking. The gages being now ready for hardening, the size block shown in Fig. 4 was made. This consisted of tool steel ¾" square milled on four sides and on the ends .010 longer than finish size to allow for grinding, and the size of the block was then stamped on the side. The plug was then hardened and ground on four sides and the gages being also hardened, were ready for grinding. The knee was clamped on a Brown & Sharpe surface grinder with the face F, Fig. 2, up; the lip H was placed in a slot in the table of the grinding machine and clamped with bolts through holes I, and finally the gage was clamped to the knee.

An emery wheel of the hardest quality ground each end of the gage, a hard wheel being used so as to retain a straight surface on the sides of the gage as long as possible. The lapping was done by the use of a round plug 1.500" long. This plug was made of cast-iron faced to the length given and was charged with emery at both ends. It was then placed in a vise and the gage passed forward and back over its surface until the desired size, as determined by a limit gage exactly 1.500" long, was obtained. The gages being now completed, were handed to the foreman for inspection, together with the block, and found satisfactory. I found that with a little experience, a gage could be made in this crude way as accurate and neatly finished as any on the market. The latest advice received from that shop was that they were still making their gages in this way.

Providence, R. I. A. F. NOTROH.

* * *

COMBINATION DRAWING AND FORMING DIE.

Editor MACHINERY:

The accompanying sketches illustrate a combination drawing and forming die used for drawing cups from 1-16 inch brass and turning down a boss upon an internal circular contour. The blank is made 13-16 inch diameter with a 45 gage hole in the center, it being pierced and punched in a simple piercing and cutting die made especially for the purpose. Unusual care is taken to make the working part of the piercing punch short and rigid, in order to pierce the metal without breaking off the point of the punch. We find, however, that under the most perfect conditions the piercing punch is frequently broken, probably caused by the jarring of the press when the blanking punch is passing through the metal.

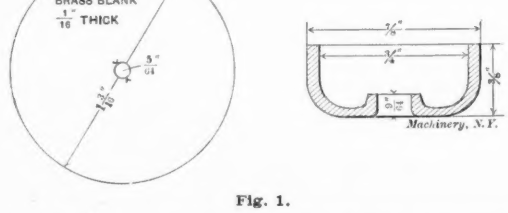


Fig. 1.

Fig. 1 shows the piece to be made with the boss produced in the center, which, in place of being drawn down, is simply opened outwardly and increased in circumference. The length and diameter are chiefly governed by the thickness and quality of the metal and by the tensile strain it will stand before breaking on the edges. Generally thick metal can be opened out more than thinner grades, as it seems to endure more stretching and the walls decrease perceptibly in thickness before cracks appear on the edge. If the die is properly made the cups will be drawn up complete in one operation, with an even edge, both as to the boss and the external walls.

Fig. 2 shows a vertical axial section of the upper die; A is the holder secured to the ram of the press by the dovetailed method;

B is a cast-iron piece, with a 2" x 3" hole machined through it, completely surrounding the upper part of the ejector. C is a tool-steel plate into which the forming die is threaded. The parts B and C are located by two dowel pins and fastened to the holder A by four ½-inch screws, two of which are shown in the sketch. D is the working part of the upper drawing die screwed tightly to plate C. Through its center is a ¾-inch hole for the ejector E to operate, which is screwed into plate F and held down in an extended position by four coil springs made from ⅛-inch wire, two of which are shown at G. Retained in the ejector by a 5-16" screw is the punch H for turning down the boss on the inside of the work. Its lower end is slightly tapered and rounded on the point. For stripping the work from the punch H, after the ejector has forced it out of the die D, there are two spring pins I, supported in their proper positions by 3-16" headless screws. In order to do the work these pins must be backed up by strong springs.

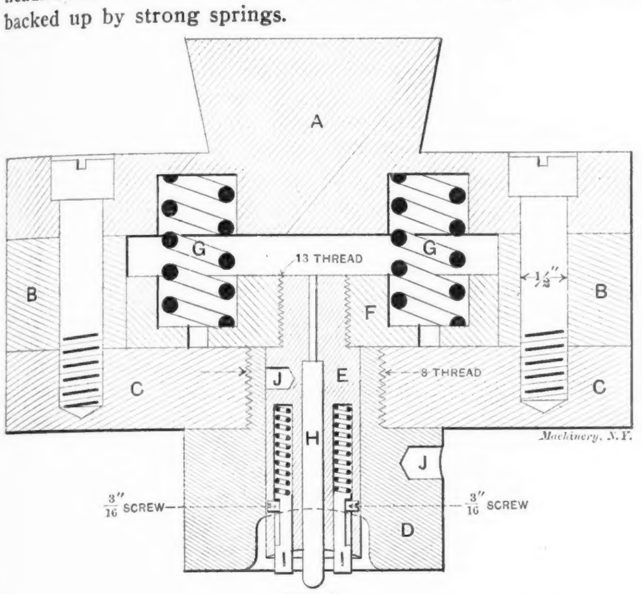


Fig. 2.

A taper of one or two thousandths to the inch on all drawing punches, when possible, will aid materially in stripping the work, as the writer has found by experience that the fixtures for removing work from both punches and dies form an item of considerable expense. The holes J are for inserting pins to remove parts when necessary. As the ram of the press descends, the springs G give way and the ejector backs up against the holder A and forms an unbroken contour with the interior of the die D. Consequently when the press is adjusted to its proper height, the cup is given the required shape.

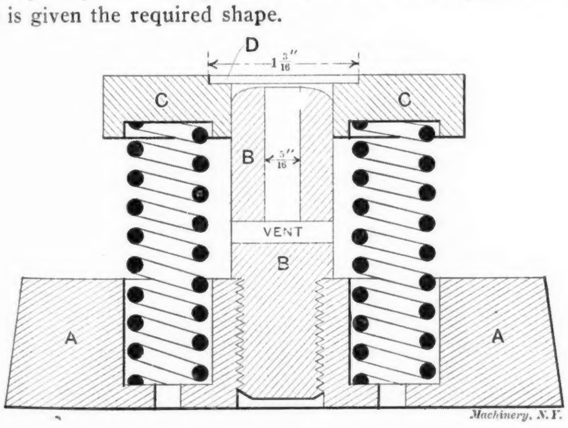


Fig. 3.

The arrangement for the lower die, Fig. 3, consists of the cast-iron base, A, 6" long by 4" wide and 1 inch thick, beveled on the sides to key into the holder. The forming stud B is threaded in its lower end and screwed into A, the top being forced the required shape of the cup. Drilled down from the top in the center of the stud is a 5-16 inch hole to meet on the other one from the side, to allow the boss on the work to form and also to permit the air to enter and escape, vents being essential in all drawing dies. The stripper C is made from hardened tool steel and the working surfaces are polished to facilitate the drawing of the blank when clamped between the faces of the stripper and the upper die. D is an opening 3-64 inch deep which admits the blank and gages it centrally. Six coil springs, made from ⅛-inch wire (two of them are shown in the drawing), support the stripper plate. These springs are arranged around the stud at an equal distance apart. Passing up through the bore A on opposite sides, at points between the springs, and entering the plate C are two ⅜-inch screws that limit the upward movement and that hold it about even with the top of the stud. To prevent the screws from working loose, we used check-nuts on them directly under the plate.

In order to properly smooth out the walls of the cup, we made the forming stud in the lower die 7-64 inch less in diameter than the opening in the upper die, consequently giving a rather tight fit when using 1-16 inch brass. In general in drawing work the difference in the diameter of the upper and lower die is not always twice the thickness of the metal; the tools have to be varied according to conditions. By practice and long experience only can the die maker become familiar with drawing metals and the correct making of this class of dies.

Lynn, Mass. C. H. Rowe.

* * *

EASY METHOD OF SPACING DIAL PLATES.

Editor Machinery:

The following method of spacing dial plates is not absolutely accurate, but will give good enough results for most purposes. There is a method somewhat similar to the one given by Mr. Emerson in July Machinery that will divide a dial in an exactly equal number of divisions, but, as it is quite complicated, I will defer a description until another time.

After the plate has been faced and bored, it is put on an arbor and placed in the milling machine and a number of notches milled with a cutter the shape of those in plate in Fig. 1, equal to the desired number of holes. Owing to the play in the indexing head of the miller, the clamp shown in Fig. 2 has to be used. This is bolted to the table of the miller, and the plate clamped between the two pins. The plunger in the index plate of the

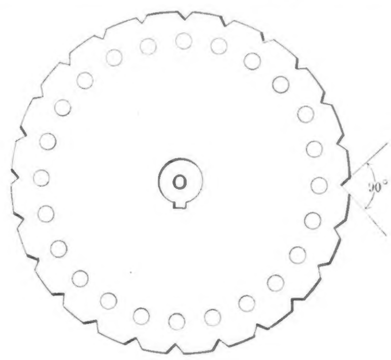


Fig. 1.

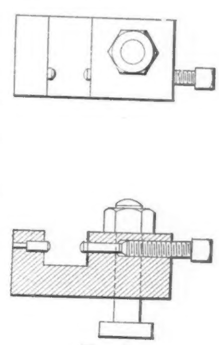


Fig. 2.

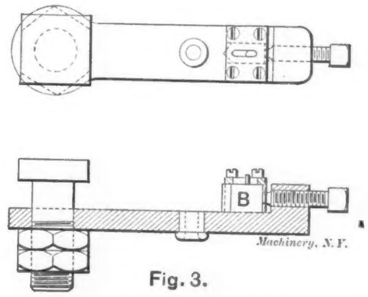


Fig. 3.

miller should not be turned beyond the desired hole and then brought back, as the plate being spaced will not be advanced the required distance on account of the play in the head. The plunger should be brought opposite the right hole and pushed in, the plate clamped between the two pins and the notch milled.

When the notches are all milled, the holes are drilled and reamed by means of the jig shown in Fig. 3 which is fastened to the plate with the bolt and lock nuts at the center O. The jig is revolved about the center until the plunger B is opposite one of the notches. It is then clamped with the set screw, and a hole drilled through at the bushing and so on for each notch. Two bushings are used, one for the drill and the other for the reamer.

The results obtained depend upon the accuracy of the miller head and the care taken in drilling and reaming the holes.

Philadelphia, Pa. Win.

BACKING OFF CUTTERS.

Editor MACHINERY:

The following is a description of a fixture for backing off formed milling cutters and also a photograph showing samples of the work accomplished by using this fixture.

The device is applied to a 16-in. lathe, which, as will be noted, has a taper attachment. The two essential parts of the device are the cam A, which is made with the same number of teeth that the milling cutter has, and the arm B. The cam is put on the gear stud in place of the first change gear of the lathe, and the arm is bolted at the left-hand end to a piece H, which, in turn, is pivoted to the taper attachment by the same bolt that is used to attach the cross slide of the lathe to the taper attachment for ordinary work. The right-hand end of the arm B has a hardened steel roll, which is held in contact with the cam A by means of the spring C. This end of the arm is supported by the casting E, bolted to the end of the lathe bed. This casting has a roll upon which the end of B rests, so as to reduce the friction as much as possible when B moves back and forth under the action of the cam A. The cross slide of the lathe is fastened to the arm B by a cap screw at G. In operation, as the arm moves out and in for every tooth of the cam and also of the cutter, the tool moves out and in a corresponding amount, and so backs off each tooth of the cutter. To provide for longitudinal adjustment when the carriage is moved one way or the other there are slots in the arm at S S through which the cap screws pass and bolt the arm B to the piece H. It is necessary to have the arm B very stiff, and it is, in this case, made of two 2½ x ¾ in. steel, and stiffened by a truss on the inside. Strap C, attached to the lower feed cone, passes over the upper feed cone and supports a weight at its end. This is to take up the back lash of the cam. This apparatus works very satisfactorily, as can be judged from the samples of work shown in Fig. 2.

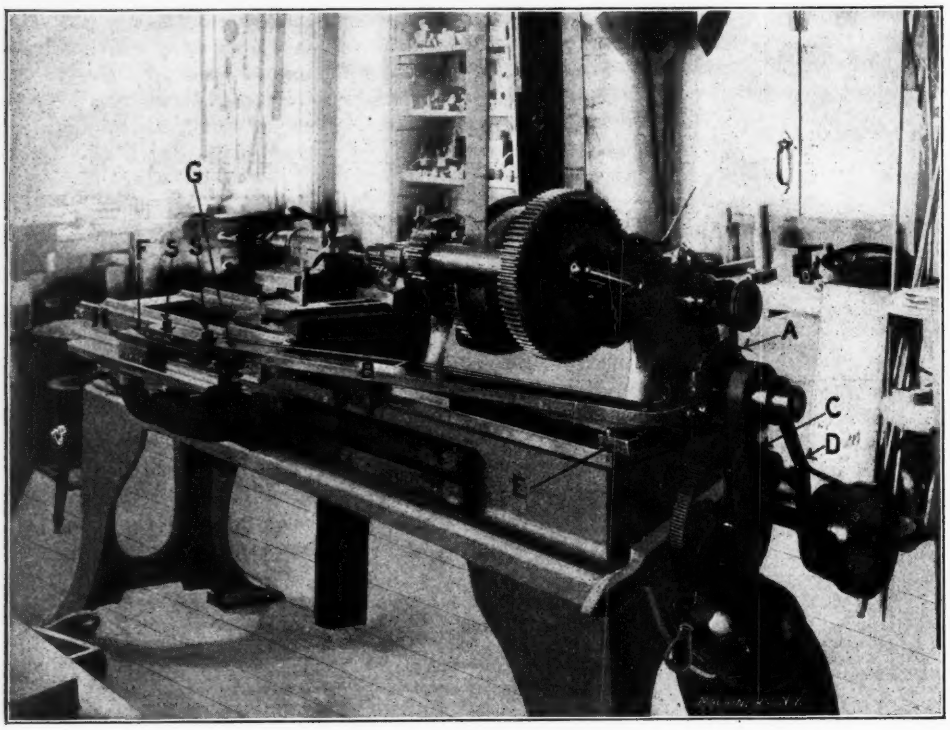


Fig. 1. Backing-off Device Applied to Lathe.

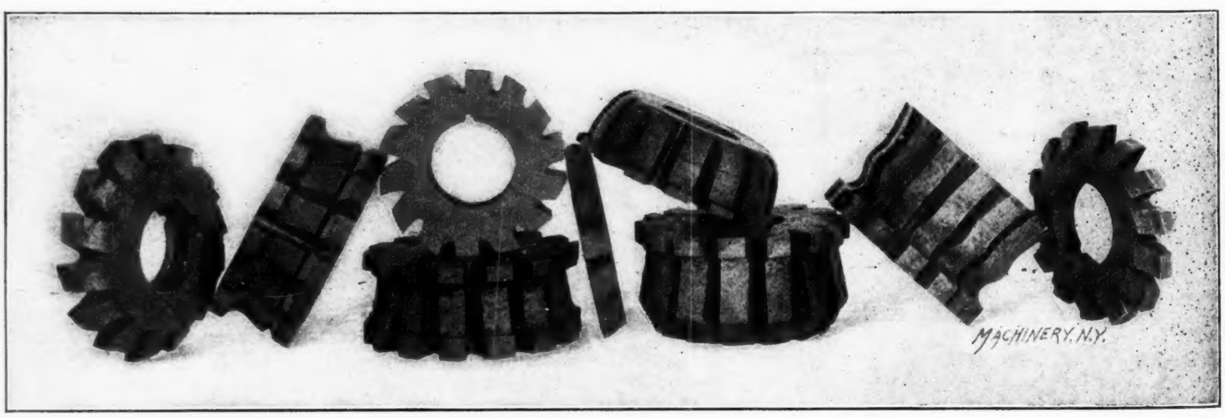


Fig. 2. Samples of Work Done.

Lawrence, Mass. FRED. J. PERRY.

* * *

REMARKS ON MACHINE TOOLS.

Editor MACHINERY:

Perfection in machine tools should not alone mean complete accuracy. Protection from injury to the operator and accessibility to working parts are paramount features. I do not mean to say that all gears and driving parts should be cased over, but that the operator by using a reasonable amount of care should be safe from injury. Every sort of contraption imaginable is being put on machine tools, apparently *without* any thought being given to the injury which may befall any one luckless enough to come in contact with it. It is very seldom that a mechanic gets caught between the teeth in gears or in anything of which he can see the danger. A short time ago the writer was called on by one of the men in the shop to look over a lathe he was working on. The man in turning the cone around used the face gear of the lathe (it was not belted), as this enabled him to get a better grip. Suddenly he gave a yell and ran up and down the shop. After he had calmed down he displayed a finger that was a horrible sight. The nail had been completely pulled out. In looking for the cause I found a harmless looking belt guard fastened to the headstock, but unlike the ones in general use, it ran parallel with the face gear and to within about ⅛ inch of the teeth of the gear. I can assure you it was the easiest thing out to get caught in that trap; for some time later I was examining another lathe of the same make; I turned that fatal gear and the next moment I, too, was examining a finger that was minus the nail and "a little bit off the top."

Danger even lurks in some of our old friends the feed handles and wheels. It is not safe to take hold of them and turn them around without first finding out if there is space enough for the hand between the wheel or handle and the nearest projection. The advisability of having all working parts of machinery accessible is something to which the tool builders should give serious consideration. Of course, all parts cannot be placed on the outside and no one expects them to be; nor can it be expected that the machines will be fitted with a lever whose movement will disconnect and remove any piece desired. But it is

expected that parts can be removed without turning the machine or shop upside down. Many a first-class tool has been condemned for this reason. Some part of minor importance slips or breaks, and upon examination it is found that it would take too long to get it apart, repair and replace it; consequently it is allowed to run until the seat of the trouble is forgotten and the machine is condemned by those that use it.

Using solid bores in large, wide machines where it is possible to use split ones is another detriment to getting machines apart, especially so on large, wide planers. These machines, like all others, are generally placed in the shop to the least advantage in regard to space, being sometimes lined up against the wall or having other large machines ranged alongside. When it is necessary to replace a worn driving pinion or to make any repair that requires taking out the driving shafts, it is usually found that no provision has been made for this. The machines alongside the wall will not allow the shaft to come out half way, and then the builder gets the usual allotment of blame in machine-shop parlance. If split boxes were used all this trouble could be avoided.

To remove the apron of a lathe should be a very simple matter, as disarrangements in this part frequently occur. If the lead-screw nut slide were fastened to the apron by bolts from the outside, instead of being made a solid part of the apron, I think another step in the progress of machine design would be made. On small lathes it is an easy matter to take out the lead screw and remove the apron, but on large ones it is entirely different. The usual way is to disconnect the apron from the saddle, block the screw up, remove the tail-end bearing and slide the apron off. But this is not always; sometimes the tail-end of that lathe goes up against something that is immovable in relation to the lathe, and then it becomes necessary to drop the lead screw and apron as a unit. If the lathe is a long and heavy one, the danger of springing the lead screw is obvious. T. B. C.

Brooklyn, N. Y.

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CUTTING CARDBOARD TAGS ON A PUNCH PRESS.

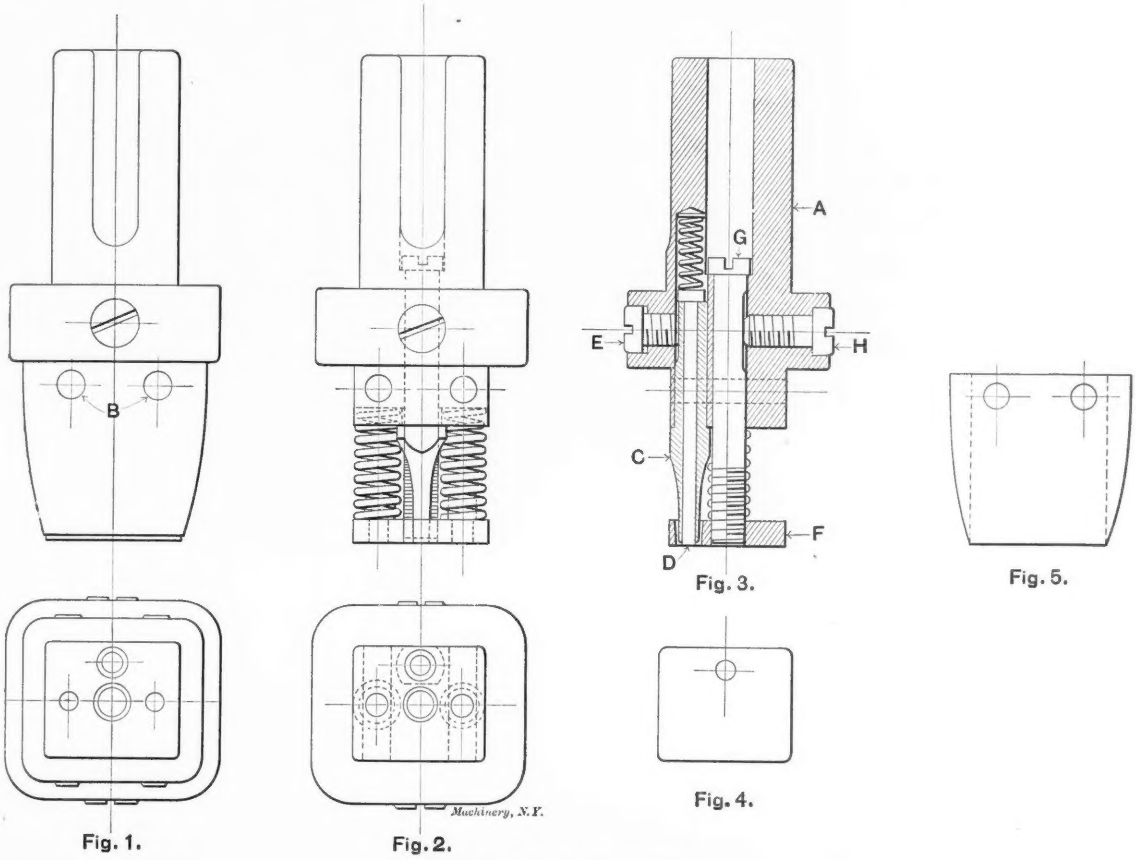
Editor MACHINERY:

The accompanying drawings show a tool for cutting cardboard tags. Fig. 1 is a side and end view of the cutter, assembled; Fig. 2, a side and end view with cutting shell (Fig. 5), and dowel pins B removed; Fig. 3, a section through punch; and Fig. 4, the tag when cut, which is ¾ x ⅞ in., with a hole ⅛ in. diameter at the top. The cutting tool consists of a body, A, that has a stem at one end to fit the punch press and the other end milled to fit the inside of the cutting shell, which is held in place by two dowel pins, B, and is backed by the shoulder of the body. The cutting shell was made from a solid piece of tool steel, worked to the form shown in Fig. 5, tempered and drawn to a dark brown color. The inner cutter, C, was made of tool steel, hardened and tempered, of the form shown in Figs. 2 and 3. There is a hole through it for the pin D, which is slightly smaller than the hole, thus allowing it to move freely under the action of the spring. The cutter is held in place by screw E and backed by the body at the shoulder.

The pin D has a spring bearing on its head, which holds it against the top of the inner cutter, and is of such a length as to project through the cutter about 1-32 in.

The plate F is held in position by the screw G, the head of which rests on a shoulder in the body and is a free fit. It is held from turning by the screw H, just touching the flattened side, but not holding it.

The plate, which is a little smaller than the cutting shell and has a clearance hole in it for the inner cutter, is adjusted by turning screw G until the plate projects about 1-32 in. below the cutting shell. It has two springs to hold it in place, as shown in Fig. 2. One end of each spring rests in a counterbored hole in the body, and the other end is held in place by a pin in the plate.



Punch and Die for Cutting Tags.

A piece of boxwood is used as a support for the cardboard in cutting. The action is as follows: Just before the tool cuts, the plate F and pin D bear on the cardboard under the spring pressure, remaining so until the cutters have done their work and have left the cardboard. This will leave the tag cut, ready to be dropped out.

Providence, R. I. EDWIN C. THURSTON.

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BRASS LININGS.

Editor MACHINERY:

While this is probably old to a great many readers, it will undoubtedly be new to some. It was a mystery to me how the brass linings in water cylinders were put in so they would be tight and smooth until I became familiar with the process from practical experience. I have put in linings from 4 inches to 24 inches in diameter and as much as 3 feet in length. The cylinder

to be bored and brass lined is chucked in a lathe or a horizontal boring-mill the same as any other cylinder. It is bored out to the proper size plus twice the thickness of the wall of the lining. The finishing cut is run at about 1-16 inch feed with an ordinary round nose roughing tool, so as to leave the bore rough, which holds the lining better than a smooth surface would. The end of the barrel or cylinder is chamfered inside so as to lay the lining over and not leave a sharp corner. After this is done the lining is pulled in, sometimes it falls in, but it can be spun out to size just the same. If the lining is too large on large barrels, it can be bent in and the burnishing tool will straighten it out. The burnisher consists of a piece of steel (I find mushet steel the best), the same as the boring tool, ground round on the end and polished perfectly smooth. It is inserted in the bar the same as the boring tool and set out so it will make an impression in the brass. The bar is revolved and fed through just the same as when boring, only using a finer feed and using oil to keep the burnishing tool from cutting. It will cut sometimes in spite of anything you can do and make it necessary to run through several times extra. If it is a brazed lining, it is necessary to take a light cut through so as to have it round and then a light burnish to take the tool marks out. After the burnishing is completed, lay the ends over and trim them off even with the cylinder and the job is done. JOHN MOORE.

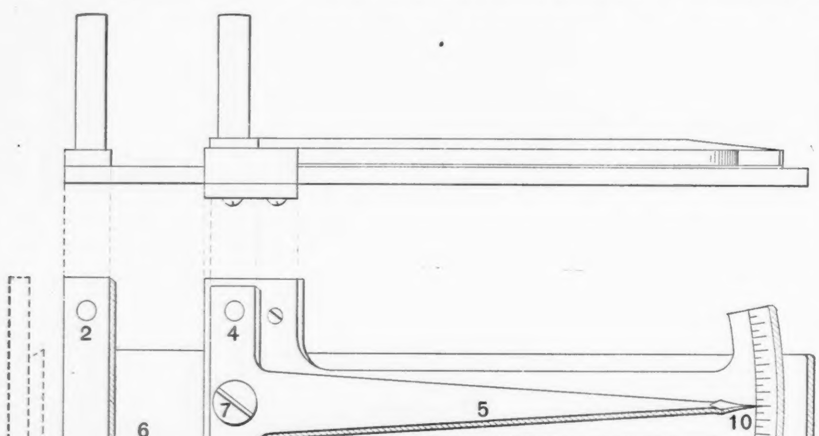
Dayton, Ohio.

* * *

TOOL FOR MEASURING TAPERS.

Editor MACHINERY:

I send herewith a sketch of a new tool which I have made and which has certainly proved very useful. It is a tool for measuring tapers on dowel pins, reamers, drill shanks or anything to be tapered. Most all machinists know that to find the taper of a shank they must use their calipers for one end and reset them for the other end; or else caliper two places, say, three inches apart, and if, for instance, the difference should be 1-16 in., they must multiply this difference by four to get the taper per foot. With the tool above mentioned, you save all this trouble in calipering and figuring. Simply place the shank or reamer to be measured between pins 1, 2, 3, and 4 and slide 8 and 9 together (see sketch). Then the taper can be read at once on the graduated scale. The construction of the tool will be readily understood. The body, or base, 6, has a cross piece supporting the two pins 1 and 2. On this slides piece 9, which has at its right end the graduated segment. The screw, 7, is fast to piece 9, and upon it swivels the pointer 5, which carries the two pins 3 and 4. Thus these two pins can be brought into contact with a tapered piece of any diameter within the capacity of the tool, and the swivel screw 7 allows the pins to adjust themselves to the taper of the work and the pointer 5 to move to the left or right, showing instantly the taper per foot.



Taper Gage.

As the pins 1 and 2 are 1½ in. apart, which is ⅛ of a foot, and from 7 to 10 is 4½ in. long, which is three times longer than the distance between 1 and 2, the graduations should be about 3-64 in. apart.

At the G. A. Gray Co.'s shops, where I am tool maker, we have a lot of taper work to do, and we found it very inconvenient to measure and caliper, but with this tool I simply slide 8 and 9 together until pins 1, 2, 3, and 4 bear, then see what 10 reads, and I have it.

If any of your readers have the time I would advise them to make one of these tools and try it. I will give any further information desired concerning it.

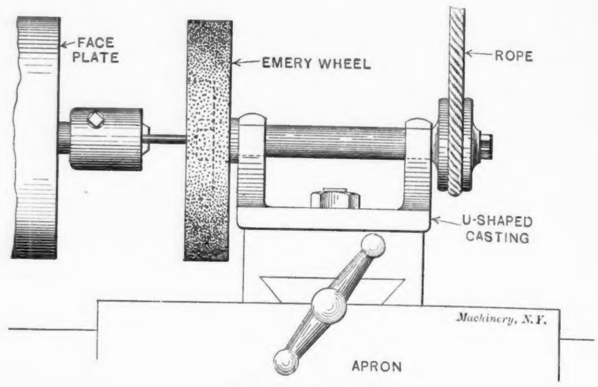
Cincinnati, O. JOHN ASPENLEITER.

* * *

GRINDING THE ENDS OF GAGE RODS IN THE LATHE.

Editor MACHINERY:

In making a number of gage rods for car-wheel tires and centers I found that tempering the ends of the rods changed the measurement considerably. And, moreover, facing the rods off



Grinder Attachment.

in the lathe and finishing with file and emery cloth was not a satisfactory way of doing the work. I made a rig for grinding the ends in the lathe after they were tempered, which worked much better, and was made as follows:

A small U-shaped casting was procured, the under side faced off, and a hole drilled through the bottom piece. It was then secured to the carriage of the lathe by means of a square-head bolt, which fitted in the T-slot of the carriage in place of the tool post. In this position the upright arms of the U were drilled to receive the arbor, bringing the holes in line with each other. The arbor was then made as indicated, one end to hold the emery wheel, which was from a drill grinder with a 1 inch face on the side, and the other to receive a small sheave pulley. The latter, when in place, adjusted the arbor nicely for end motion, since it was made to clamp up against a shoulder on the end of the arbor. A larger wooden sheave was made in halves out of the 1¼-inch plank and secured to the countershaft by means of L-shaped pieces, fastened to the halves of the sheaves, through which bolts were passed to hold them together. A cotton rope was used to drive with. There was stretch enough to allow for the 1 inch of travel of the carriage.

The rods to be ground were passed through the hollow spindle of the lathe and held with a drill chuck. A slightly tapered piece, with a hole in the center which was a nice fit on the rods, was fitted to the back end of the spindle. This kept the end of the rod from wabbling and made the length run very true. The ends of the rods were pointed with a tool and faced to within 1-64 of size. They were then stamped and tempered, after which the emery wheel was used to grind the ends to proper size.

I also use the rig in grinding the centers of the lathe, setting the emery wheel on an angle and using the compound carriage. I have also ground reamers and taps to proper size with this. The time consumed in making was only five hours.

Lancaster, N. Y. R. B. CASEY.

* * *

According to a summary recently published in the "Locomotive" there were in the United States during the twenty-one years from 1878 to 1900, a total of 5,199 boiler explosions in which 6,118 persons were killed and 8,651 injured.

EXAMPLES OF MILLING.

The Becker-Brainard Milling Machine Co., Hyde Park, Mass., have sent us an interesting group of photographs, illustrating the extended variety of work that they are doing regularly on the Becker vertical millers that they have in their works. These

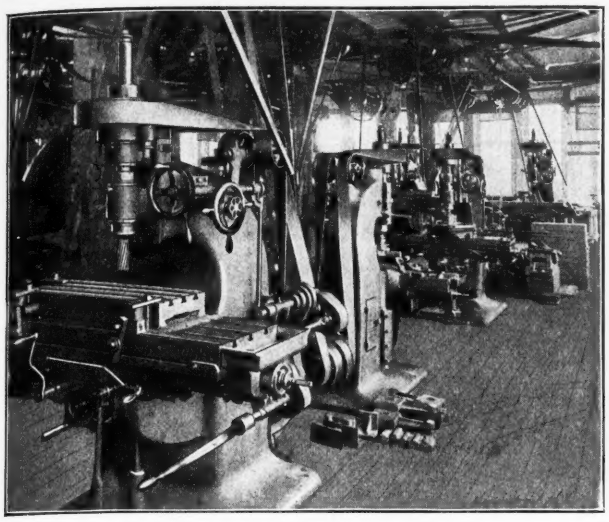


Fig. 1. View of Milling Machines in Shop.

machines are employed regularly in the building of the milling machines of this company and have reduced the time that was formerly taken to produce the same pieces upon the lathe or planer. The fact that the table of the machine may have either

Fig. 2.

Fig. 3.

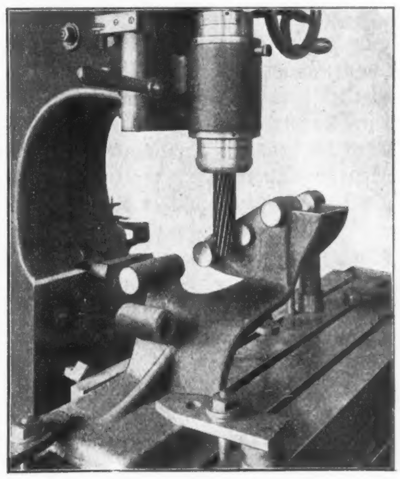


Fig. 4.

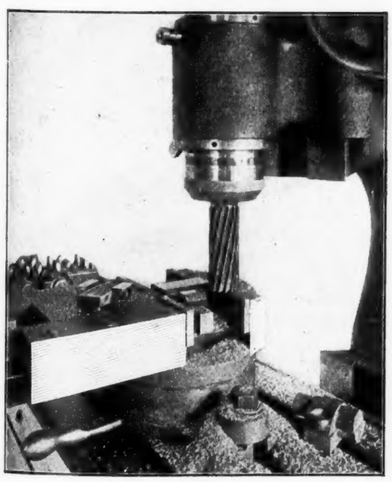


Fig. 5.

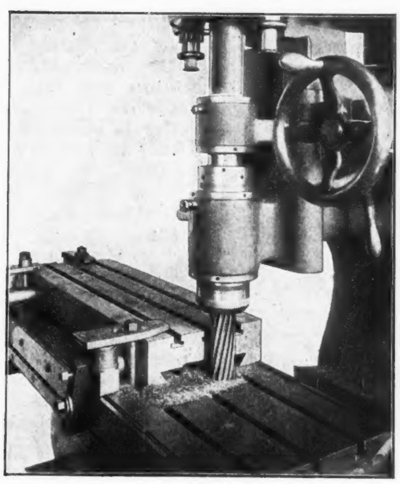


Fig. 6.

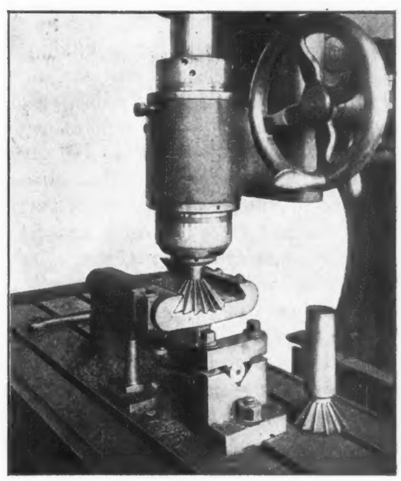


Fig. 7.

Examples of Work being Performed on the Becker Vertical Miller.

a rectilinear or a rotary feed makes it possible to do circular milling as well as plain milling, and in the case of formed or irregular work time can thus be saved on pieces that would ordinarily be finished in a lathe.

The view, in Fig. 1, shows the machines as they appear in the shop and the following is a brief description of the group illustration, giving details of the work:

Fig. 2, No. 6 machine: shows angle mill finishing the bevel face of a circular casting; compared with lathe work, the vertical milling machine does this work 1-3 faster, and one machinist runs two machines. Also, the same cutter bevels the internal face of another ring fitting the one shown—thus eliminating all possibility of error by the workman.

Fig. 3, No. 6 machine: shows a rose-mill finishing a recess in the periphery of a circular casting. Economy over lathe work, same as in Fig. 2.

Fig. 4, No. 5B machine: shows an end mill finishing spots on the inside surface of a feed bracket casting; same tool also finishes upper edge of casting. Economy over counter-boring, 10 to 1.

Fig. 5, No. 5B machine: shows end mill finishing brasses. "The odd job"; not enough of them wanted to pay for making a gang cutter. Combined side and end cutter does in one hour what a shaper would accomplish in six hours.

Fig. 6, No. 5B machine: shows side mill finishing ends of table. Economy as compared with planing, 3 to 1.

Fig. 7, No. 6 machine: shows 40° angle mill finishing V's of sliding head. This head is 10" long and 6" wide inside. It is finished fully in 50 minutes. Same job on planer formerly took three hours.

* * *

Tungsten is a rare metal, and a very valuable one in metallurgy, as it is the active agent in "self-hardening" steels. The addition of only nine per cent. of tungsten makes the Sheffield 'Mushet" self-hardening steel which sells for several times the price of the ordinary qualities of tool steel. A peculiarity of tungsten steel is its high permanent magnetic qualities, being nearly double that of the best tool steel and twenty times that of Bessemer steel. Tungsten is found in Germany, Bohemia, Cornwall, Texas and Nova Scotia, but the annual production does not exceed 1,000 tons.

THE PARIS AWARDS.

LIST OF TOOL MANUFACTURERS WHO RECEIVED PRIZES AT THE EXPOSITION.

On the 18th of August the awards were made to the exhibitors at the Paris Exposition. The accompanying list of awards is taken from the New York Times, which paper has published the most complete list that has appeared so far as we know. The awards that we print are those of the department of machinery and electricity, and we publish only the names of firms who are machine tool builders or are manufacturers of products in which our readers are most generally interested.

At the time of this writing there is very little information to be obtained with regard to the basis on which the awards were made, but we believe that any unprejudiced reader who carefully examines the list, and who is familiar with the machine tool industry of the country, will be surprised at the prizes allotted in many instances, where firms receiving the lower awards are known to produce machines or tools bearing only the highest reputation. This is particularly to be regretted in the case of firms showing machines of strictly original and novel design.

Starting with those who received the grand prize or a gold medal, it will be noted that they number some of the older and better known firms who justly deserve the distinction and honor conferred upon them. They have previously exhibited at home and abroad and have always sustained the excellent reputation with the jurors that they have earned with the manufacturers who buy their products.

Turning to the winners of silver and bronze medals, also, it will be seen that there are many manufacturers who showed tools with all the essential qualities of a good machine; and there is not the difference in them to warrant an unprejudiced judge in saying one should have a silver medal, another a bronze medal, or none a gold medal.

We understand it to be one of the peculiar regulations of the jury that no machine not having been exhibited or received an award previously at an exposition in Paris, shall receive higher than a bronze medal. This is, to say the least, a peculiar ruling and we believe there is a serious objection to invariably giving gold medals only to the old-established concerns while the newer ones must rest content with the cheaper medals.

Another regulation that we understand exists is that awards shall be made not only on the merits of the machines themselves but also upon the extent and completeness of the exhibit as a whole. A complete line of machines is more likely to receive a high rank than one or a few machines representing only a part of a builder's output. While there is more or less justice in this condition, the general impression that the public receives from an award is that the gold medal stands for a machine of the finest quality, a silver medal for a poorer machine, and so on. That this is not necessarily the fact, should be borne in mind and, in view of this and the other conditions which have led to the results decided upon by the jury, one is led to believe that there is very little satisfaction in exhibiting in competition for a prize. We also understand that the highest prize allowed on certain classes of exhibits, like small tools, for example, or where only one machine is shown, is a silver medal.

While we do not wish to accuse the jury of any intended unfairness, preferring to believe, rather, that the unsatisfactory results are due to the system instead of the personality of the organization, we find there is a quite general impression that there were not the systematic arrangements, the attention to details, and the personal examination that there should have been. One firm, for example, had two exhibits; on the smaller and less important one a gold medal was received and on the larger and more complete, a silver medal. Another builder has told us that he was surprised at receiving an award at all, in that when he arrived at Paris it was about the middle of July, after the judges had been through the American building. At that time his machines were still on the skids uncleaned and the small stuff boxed, making a careful examination of the machines impossible. A factor that evidently counted very strongly was having a man on the grounds in charge of an exhibit who was able to show the jurors suitable attention and explain to them in detail such points as they wished to know. Concerns who were able to do this in general fared better than those having machines in charge of a Paris agent.

It was but natural that the jurors should try to make the awards with the least possible work in what is, at best, an onerous undertaking. An exhibit in charge of a representative who was able to spend some time with the members of the jury previous to the awards would very naturally make a deeper impression upon them than would an exhibit with no one to properly present the claims of the tools shown.

Not in Competition.

Standard Tool Co., Cleveland, Ohio.

Grand Prizes.

Brown & Sharpe Mfg. Co., Providence, R. I.
The Pratt & Whitney Co., Hartford, Conn.
Bliss (E. W.) Co., Brooklyn, N. Y.
Niles Tool Works Co., Hamilton, Ohio.
J. A. Fay & Egan Co., Cincinnati, Ohio.

Gold Medals.

Chicago Pneumatic Tool Co., Chicago, Ill.
Morse Twist Drill and Machine Co., New Bedford, Mass.
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Hendey Machine Co., Torrington, Conn.
Warner & Swasey, Cleveland, Ohio.
Norton Emery Wheel Co., Worcester, Mass.
Bement, Miles & Co., Philadelphia, Penn.
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Company, Springfield, Vt.
Reed (F. E.) Co., Worcester, Mass.
Bullard Machine Tool Co., Bridgeport, Conn.
Pond Machine Tool Co., Plainfield, N. J.
Bullock Electric Mfg. Co., Cincinnati, Ohio.
Olsen (Tinius) & Co., Philadelphia, Penn.
William Sellers Co., Philadelphia.

Silver Medals.

Ferracute Machine Co., Bridgeton, N. J.
Cleveland Twist Drill Co., Cleveland, Ohio.
Rice Gear Co., Hartford, Conn.
Landis Tool Co., Waynesboro, Penn.
Prentice Brothers Co., Worcester, Mass.
Q. and C. Co., Chicago, Ill.
Walworth Mfg. Co., Boston, Mass.
Starrett (L. S.) Co., Athol, Mass.
Gleason Tool Co., Rochester, N. Y.
Flather & Co., Nashua, N. H.
Springfield Machine Tool Co., Springfield, Ohio.
Baker Brothers, Toledo, Ohio.
Acme Machinery Co., Cleveland, Ohio.
Horton (E.) & Son Co., Windsor Locks, Conn.
Ingersoll Milling Machine Co., Rockford, Ill.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Curtis & Curtis Co., Bridgeport, Conn.
Flather Planer Co., Nashua, N. H.
Lunkenheimer Co., Cincinnati, Ohio.
Mietz & Weiss, New York.

Bronze Medals.

Bickford Drill and Tool Co., Cincinnati, Ohio.
Cincinnati Planer Co., Cincinnati, Ohio.
Standard Pneumatic Tool Co., Chicago, Ill.
Quint (A. D.), Hartford, Conn.
Le Blond (R. K.) Machine Tool Co., Cincinnati, Ohio.
Dock, (Herman,) Philadelphia, Penn.
Safety Emery Wheel Co., Springfield, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
Geometric Drill Co., New Haven, Conn.
Potter & Johnston Co., Providence, R. I.
Barnes (W. F. & John) Co., Rockford, Ill.
Builders' Iron Foundry, Providence, R. I.
Westcott Chuck Co., Oneida, N. Y.
Waterbury Tool Co., Waterbury, Conn.
Grant Machine Tool Works, Cleveland, Ohio.
Gorton (George) Machine Co., Racine, Wis.
Goodell-Pratt Co., Greenfield, Mass.
Oster Mfg. Co., Cleveland, Ohio.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
American Tool and Machinery Co., Boston, Mass.
American Machinery Co., Grand Rapids, Mich.
Pearson Machine Co., Chicago, Ill.
Bradford Machine Tool Co., Cincinnati, Ohio.
American Turret Lathe Works, Wilmington, Del.
Trimont Mfg. Co., Boston, Mass.
Oneida National Chuck Co., Oneida, N. Y.
Fosdick & Holloway Machine Tool Co., Cincinnati, Ohio.
Prentiss Vise Co., New York.
Hart Mfg. Co., Cleveland, Ohio.
Pratt Chuck Co., Frankfort, N. Y.
Vitrified Wheel Co., Westfield, Mass.
Armstrong Brothers Tool Co., Chicago, Ill.
Sprague Electric Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
Thresher Electric Co., Dayton, Ohio.

Honorable Mention.

D'Amour & Littledale Machine Co., New York.
Slocomb, (J. T.,) & Co., Providence, R. I.
Almond, (T. R.,) Brooklyn, N. Y.
Ransom, (Perry,) Oshkosh, Wis.
Nicholson, (W. H.,) & Co., Wilkesbarre, Penn.
Walker, (O. S.,) & Co., Worcester, Mass.
Universal Machine Co., Providence, R. I.
Leland Faulconer Mfg. Co., Detroit, Mich.
A. L. Henderer's Sons, Wilmington, Del.

* * *

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published.

8.—C. K.: 1. When quartering locomotive driving wheels, at what distance apart is it necessary to set the trams to get the four points of a circle, or, in other words, how is the square inscribed in the circle. 2. When chasing threads on a lathe how can I catch the thread without a backing belt, when the number of threads per inch of the piece threader is not exactly divisible by the number of threads per inch of the lead screw?

A.—The "quarter" points are found by trial, as it is the most reliable method. It is practically impossible to calculate the distance to set the trams and get accurate results, not because the side of an inscribed square cannot be easily found by calculation, but because the accurate measurements required to make such calculations accurate are more difficult than the "stepping" process employed. To find the side of an inscribed square by calculation, square the diameter, divide the result by two and extract the square root of the quotient. Thus to find the side of an inscribed square when the diameter of the circle is 4 feet, we have $4^2 = 16$. One-half of $16 = 8$ and the square root of $8 = 2.828$. Therefore, the tram points should be set 2.828' apart to quarter the circle. The process followed in "quartering" loco-

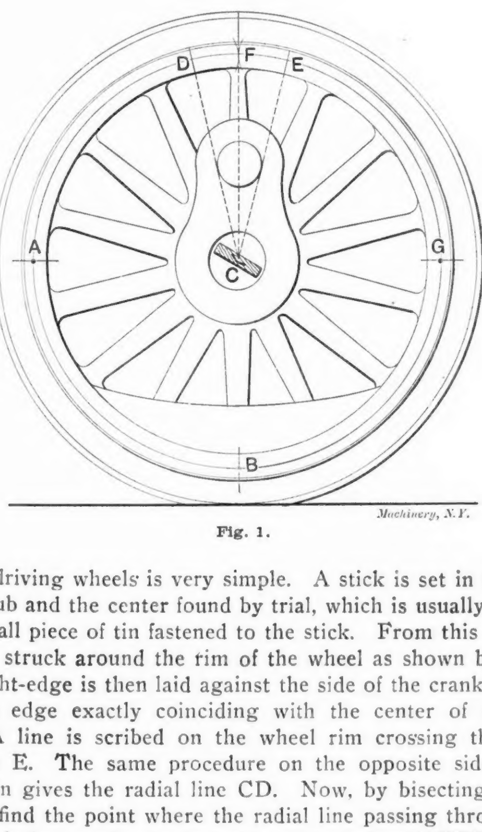


Fig. 1.

motive driving wheels is very simple. A stick is set in the bore of the hub and the center found by trial, which is usually pricked on a small piece of tin fastened to the stick. From this center a circle is struck around the rim of the wheel as shown by ABG. A straight-edge is then laid against the side of the crank pin and with its edge exactly coinciding with the center of the axle bore. A line is scribed on the wheel rim crossing the circle ABG at E. The same procedure on the opposite side of the crank pin gives the radial line CD. Now, by bisecting the arc ED we find the point where the radial line passing through the center of the crank pin intersects the circle ABGDE or the point F. This is the starting point for "quartering" the circle which is done as before stated by setting the trams and "stepping" around until the exact positions are verified by trial. It might be mentioned that it is not strictly necessary to "quarter" the wheels in order to set the crank pins on opposite sides at right angles, as it can be done as accurately and more quickly by simply finding the hub center and the point F for one side by which a straight-edge and level can be used to get the radial line through the crank pin horizontal. On the opposite side find the hub center and draw a circle or two arcs of the same diameter as the crank pin collar next to the wheel. These arcs must necessarily come within the bore of the hub as the axle is always larger than the crank-pin collar, so it will be necessary to set the stick at right angles to the radial line passing through the pin. By hanging a string over the crank pin collar having two plumb bobs fastened to the ends, a means is provided for adjusting the wheel so that the radial line passing through the crank-pin shall be exactly vertical. When the two lines connected to the plumb bobs exactly coincide with the two arcs scribed on the centering stick, the crank-pin is at top quarter point. It will be seen that the conditions desired are thus secured without the trouble of "quartering." 2. Probably the most popular method for catching the thread when the thread cut is not a multiple of the lead screw, is to mark the face plate and the gear on the lead screw with chalk before the first pass over the thread has been made. The marks are made so that they can be brought again into the same relative position before engaging the split nut. Thus if the face-plate be marked at the top, the gear will also be marked in the same position. Whenever these marks come the same, the lead screw can be engaged with safety. Some lathes are made with a very convenient indicator at the side of the carriage, which consists of a worm-wheel engaged with the lead-screw and with a pointer at the upper end. By noting the position of this pointer when the tool is first engaged, the thread can again be caught, as fully explained in the May, 1898, issue of MACHINERY. Another method which is seldom used, is to stop the lathe, disengage the lead-screw, run the carriage back to the starting place and then engage the split nut regardless of the position. The tool point is carefully brought to the right position by adjusting by the compound rest which has been thrown around as nearly as possible parallel with the ways of the lathe. This method can be followed with good results, but is somewhat slow and risky for any other but an expert to attempt.

Answered by Wm. Baxter, Jr.

9.—N. G.: I am interested in electricity, and wish to know if iron-clad magnets are as efficient as the common core magnet. Does the coil make a north pole of the core, and a south pole of the casing, at the same end, reducing the power?

A.—An iron-clad magnet is more powerful than one of the straight core type; it is in reality only another form of horseshoe magnet, the outer casing forming one side of the U. If the end of the core is a north pole, the end of the outer casing will be a south pole, and its presence will not destroy the tractive force of the core, but on the contrary will increase it. The force of each pole will be greater than if the outer casing was removed, and the south pole were at the opposite end of the core. The reason why the poles will be stronger is that the magnetizing capacity of the wire coil, with a given current passing through it, is more fully utilized as the length of the air portion of the magnetic path surrounding it is reduced. Air resists the development of the magnetic force anywhere from about two hundred to two thousand times as much as soft iron, so that the nearer we come to making the whole path of iron, the stronger the magnet. This is the reason why in an electric motor or generator the distance between the iron core of the armature and the faces of the poles is made as small as possible. If the magnet is magnetized very strongly, the conductivity, or permeability of the iron as it is called, will only be two or three hundred times as great as that of air, but if the magnet is magnetized to a low density, the permeability of the iron may be two thousand times as great as that of the air.

Answered by E. W. Roberts,

10.—A. K. P.: I am building a gasoline engine for a carriage. It is to be four horse-power and will have a cylinder diameter of five inches and a stroke of six inches. 1. What clearance should I give to the combustion space? 2. Is it practicable to use radiating ribs or flanges for a single cylinder engine of this size?

A.—1. Presuming that the engine is of the four-cycle type, it should have a clearance equal to about one-half the displacement of the piston. This would equal the volume of the cylinder for three inches of its length. If there are no valve boxes or pockets and the valves open directly into the compression space, the end of the piston should be three inches from the cylinder head when the piston is at the inner end of its stroke. If there are valve boxes or other openings into the compression space which

communicate with the cylinder during the compression stroke their volume should be deducted from the allowable clearance in the cylinder itself. Thus, the volume of the compression space should be 59 cu. in. and should there be a valve-box opening into the cylinder having a volume of 19 cu. in. this volume should be subtracted from the volume of the compression space leaving 40 cu. in. as the volume to be allowed between the end of the piston and the cylinder head. Dividing 40 by the area of the cylinder (19.63) it gives a little over two inches as the length of the space between the cylinder head and the piston at the end of the inner stroke. 2. It is not considered practicable to use cooling ribs on cylinders over 3½ inches diameter. In order to avoid a water jacket, you should employ two cylinders. It might be well to call the questioner's attention to the fact that a 5 x 6 four cycle engine running at 400 r. p. m. will not, as a general rule, give over 3½ horse-power. In order to derive four horse-power from an engine of this size it should be run at 480 r. p. m. and it is quite practical to run such an engine at 800 to 1,000 r. p. m., and thus derive from 7 to 8 horse-power from it. If the engine is to be employed for a carriage of the single-seat style suitable for two persons, the latter horse-powers will be nearer what will be required.

* * *

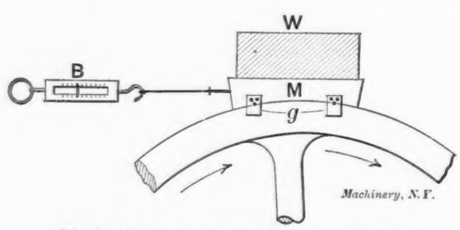
A CORRECTION.

Editor MACHINERY:

In my answer to W. H. in "How and Why" for September, I find I have omitted the consideration of the co-efficient of friction. This is unfortunate, in that it makes the results obtained from the method given, several times too large. The true resistance to the turning of the flywheel is not, as would appear from the answer referred to, the normal pressure upon the flywheel rim. The resistance to be considered is that due to the friction of the board against the surface of the wheel and is evidently Pf, where f is the coefficient of friction. The formula for finding the brake horse-power is therefore

$$B. H. P. = .0001904\ PfRN.$$

As the coefficient of friction varies not only with the materials in contact, but with the speed of rubbing, the value of f should be found for each individual case. This is not such a difficult task, as may be seen from the following explanation of the method.



Rig for determining Friction Coefficient.

Arrange a block M as shown in the figure, with an attached weight W and four guide blocks g, nailed two on each side. Be sure that the block M is of the same material as that employed for the brake. Attach the balance B by means of a cord to one end of the block as shown, set the block upon the rim of the flywheel and find the pull at B when the engine is running at its normal speed. Call this pull F. Then lift the block from the flywheel and permit to hang from the hook of the balance. The balance will now record the combined weight of M and W. Call this weight w. Divide F by w and the result is the coefficient of friction that should be used in the foregoing formula. Thus $f = \frac{F}{w}$

Twenty pounds will usually be found sufficient for w if the weights are carefully taken.

E. W. ROBERTS.

* * *

Two months ago a fire insurance expert estimated that the losses from fire in the United States and Canada during the year 1900 would reach the enormous figure of $175,000,000. It now appears that this estimate will be considerably exceeded, as the loss for the first six months was nearly $100,000,000.

* * *

The 69th meeting of the New England Manufacturers' Association will be held at Washington on October 17 and 18. While the arrangements are not fully completed, yet it is promised to be a meeting of unusual interest, while it is a favorable time to see the numerous attractions.

NEW TOOLS OF THE MONTH.

Under this heading are listed the new machine and small tools that have been brought out during the preceding month. Manufacturers are requested to send brief descriptions of their new tools as they appear, for use in this column.

LARGE ROLLER BEARINGS.

The Ball Bearing Co., Boston, Mass., have sent us photographs, from which the two following illustrations were made, of a large roller bearing and a thrust bearing of unusual dimen-

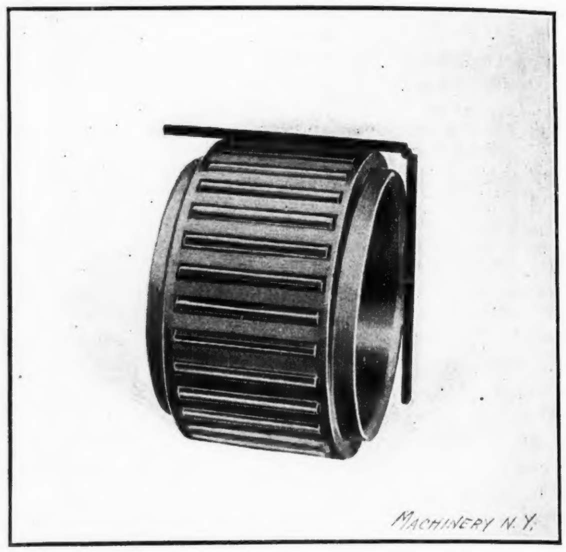


Fig. 1.

sions. These show the extent to which this company's business has developed in different directions, and also give an idea of the massive work to which roller bearings may be successfully applied. The two-foot rule in connection with Fig. 1 gives a

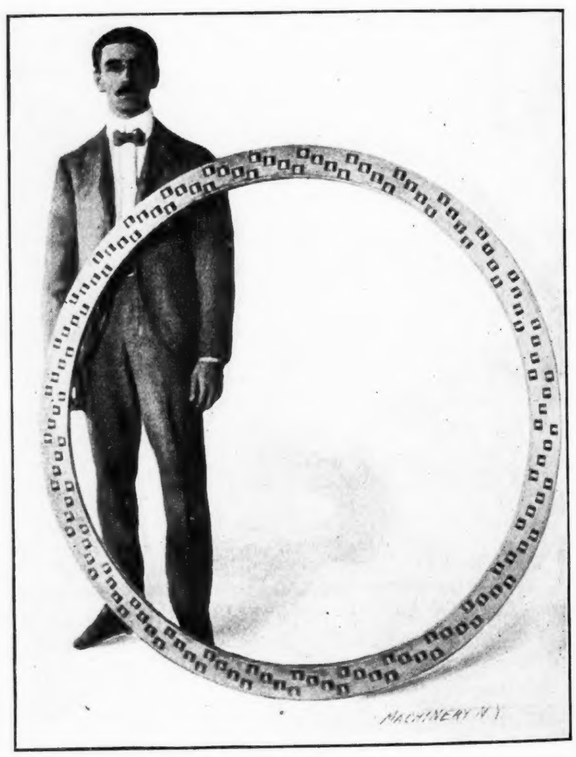


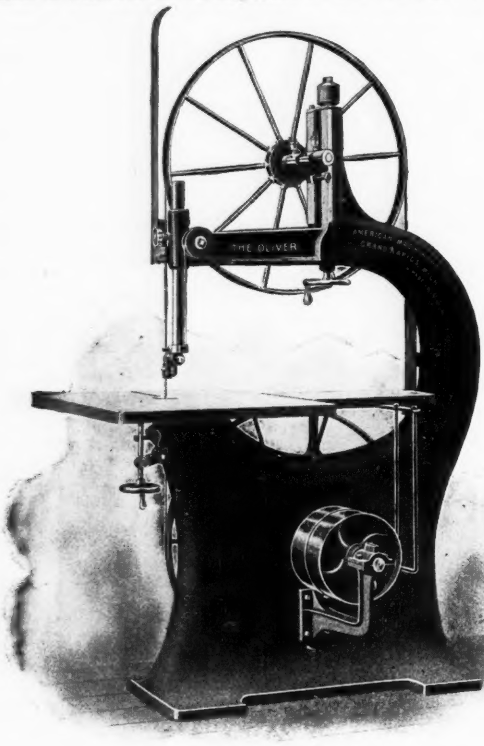
Fig. 2.

conception of the size of this bearing and the person standing by the thrust ring, will give an idea of the diameter of the thrust bearing. This latter bearing is designed to sustain a load of 80,000 pounds.

BAND SAW.

The illustration on page 64 shows a new band saw, adapted to the needs of patternmakers, that has been placed on the market by the American Machinery Co., Grand Rapids, Mich. The frame is of one piece, cored out, and the wheels are of novel construction. They have forged spokes with steel rims which

give stiffness with strength, the greatest weight of the wheel being in the cast-iron hub. Owing to the peculiar construction of the hub, the path of the saw is directly over the bearing, thus doing away with any overhanging strain. The faces of the wheels are covered with rubber bands, cemented to the rims after the latter are ground and the wheel balanced. This construction is believed to be superior to the old style with wooden

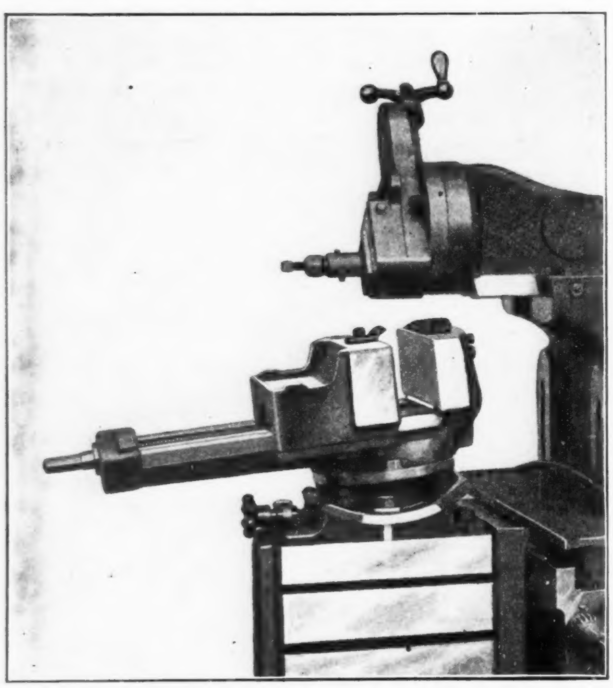


Improved Band Saw.

rims and is in line with advanced mechanical work. The upper wheel may be tilted to any angle, thus shifting the saw to the desired path, and has a vertical adjustment of 12". The table is planed to a true surface and is tilted simply by turning a hand wheel without adjusting any clamps or screws. The table is perfectly rigid in whatever position it is left. The machines may be built either right or left hand, and are provided with oil cups. The saw used is 19' long and may be from 1/8" to 2" in width.

SHAPER VISE.

The accompanying illustration shows a special tilting base for shaper vises that Gould & Eberhardt. Newark, N. J., have recently brought out. It will be found particularly useful by glass mold makers and others having occasion to use a vise for planing or milling tapering or similar work. When used in connection with the regular Gould & Eberhardt vise, the work can be held in almost any position, either above or below a horizontal line; and when used in connection with one of their shapers, the tool head can be swiveled to the right or left, thus giving two additional positions. The tilting base can be applied to vises of any make. If desired, provision will be made for applying it to other vises, upon receipt of particulars as to the dimensions of the vises and about the shaper upon which it is to be used; or, if preferred, a vise and base complete can be furnished for any machine.



Tilting Shaper Vise.

* * *

FRESH FROM THE PRESS.

A Text-Book on Mechanical Drawing and Elementary Machine Design, by John S. Reid and David Reid, instructors in mechanical drawing and designing, Cornell University, Ithaca, N. Y. Published by John Wiley & Sons, New York. 389 8vo pages, with 298 illustrations. Price $3.00.

We think this book may fairly be classed as the best elementary treatment of machine design that has been published in this country. Two years ago John S. Reid prepared a treatise on geometrical drawing and projection which was intended as an introduction to the subjects of working drawings of machine parts and machine design. The new volume supplements the first and in turn is intended as an introduction to advanced machine design. It appears to contain, however, most of the information that one would need to have at hand in ordinary drawing room work There are several excellent features that we will refer to briefly.

There is a chapter containing useful tables and miscellaneous information, notes on materials, etc., that appear to be well chosen. Following this is a chapter on bolts, nuts, cotters, fastenings, etc., which deserves commendation from the fact that while it goes into details, the author has not directed his energies towards gathering as large a collection of miscellaneous nut locks and other details seldom used, but instead has shown how to draw and proportion those fastenings that are most commonly used. There are several good locking devices; and special bolts, machine screws, foundation bolts, bolts of uniform strength, etc., receive their share of attention.

The other chapters are upon Rivets and Riveted Joints; Shafting and Shaft Couplings; Pipes and Pipe Couplings; Bearings; Belting; Gearing, treating only briefly of odontographic methods, with proportions of the rims, spokes, etc., of gear wheels; Valves, Cocks and Oil Cups, and Engine Details.

The number of drawings is unusual, and most of them have been made especially for this work and have been taken from practice. While the book is intended primarily to show the applications of the principles of mechanical drawing to machine parts, numerous tables, formulas, etc., give information upon the proportioning of such parts.

In comparison with other works, it is of about the same grade as Low and Bevis' Machine Design, published in England. It contains less in the way of calculations than Unwin's Machine Design, and is not so advanced nor does it treat of the principles of design so deeply as the recent work of Prof. Jones, of Worcester Polytechnic Institute.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

Montgomery & Co., 105 Fulton street, New York, the twentieth century edition of "The Tool Catalogue." Montgomery & Co. are well known as leading dealers of general supplies in the line of tools and hardware, and this catalogue lists completely their large stock. It is pocket-size with over 500 pages, and has a large number of cuts. They issue also for the first time a bolt and screw supplement to their catalogue.

The Newton Machine Tool Works, Philadelphia, Pa., catalogue No. 34 of milling machines, cold saw cutting-off machines, horizontal boring machines, drilling machines, slotters, etc. Many of these machines are of unusual capacity for heavy work. The catalogue is bound in cloth and illustrated.

Northampton Emery Wheel Co., Leeds, Mass., 1900 catalogue containing descriptions of grinding machinery. There are numerous interesting and instructive facts about grinding, speeds, care of wheels, etc., and the catalogue will be sent to any one asking for it.

Baxter D. Whitney, Winchendon, Mass., illustrated catalogue of wood-working machinery. The press work and the matter contained in this publication are very attractive and we believe it is a catalogue that will be appreciated by pattern makers, or any who are interested in wood-working machinery.

Arthur Koppel, 66 Broad street, New York, 1900 album showing the extended use of his narrow gage and industrial railway materials. The text is printed in several languages and the photographs are taken from industrial works located in many foreign countries.